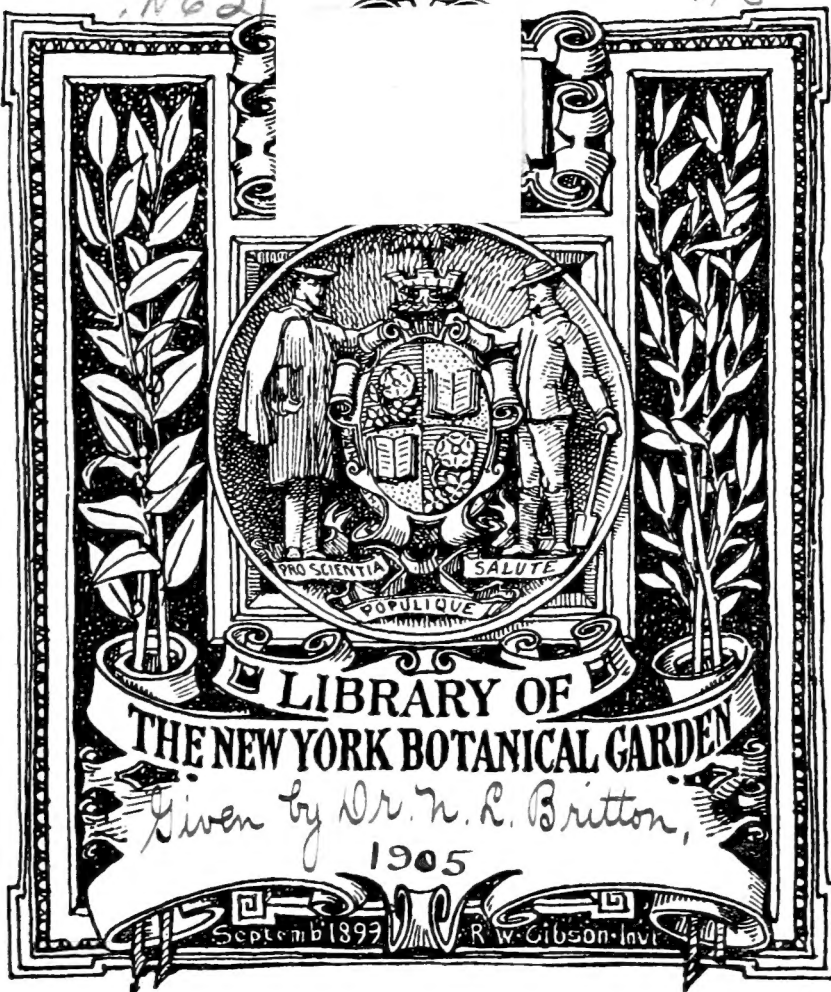




XA  
.N621

v. 8



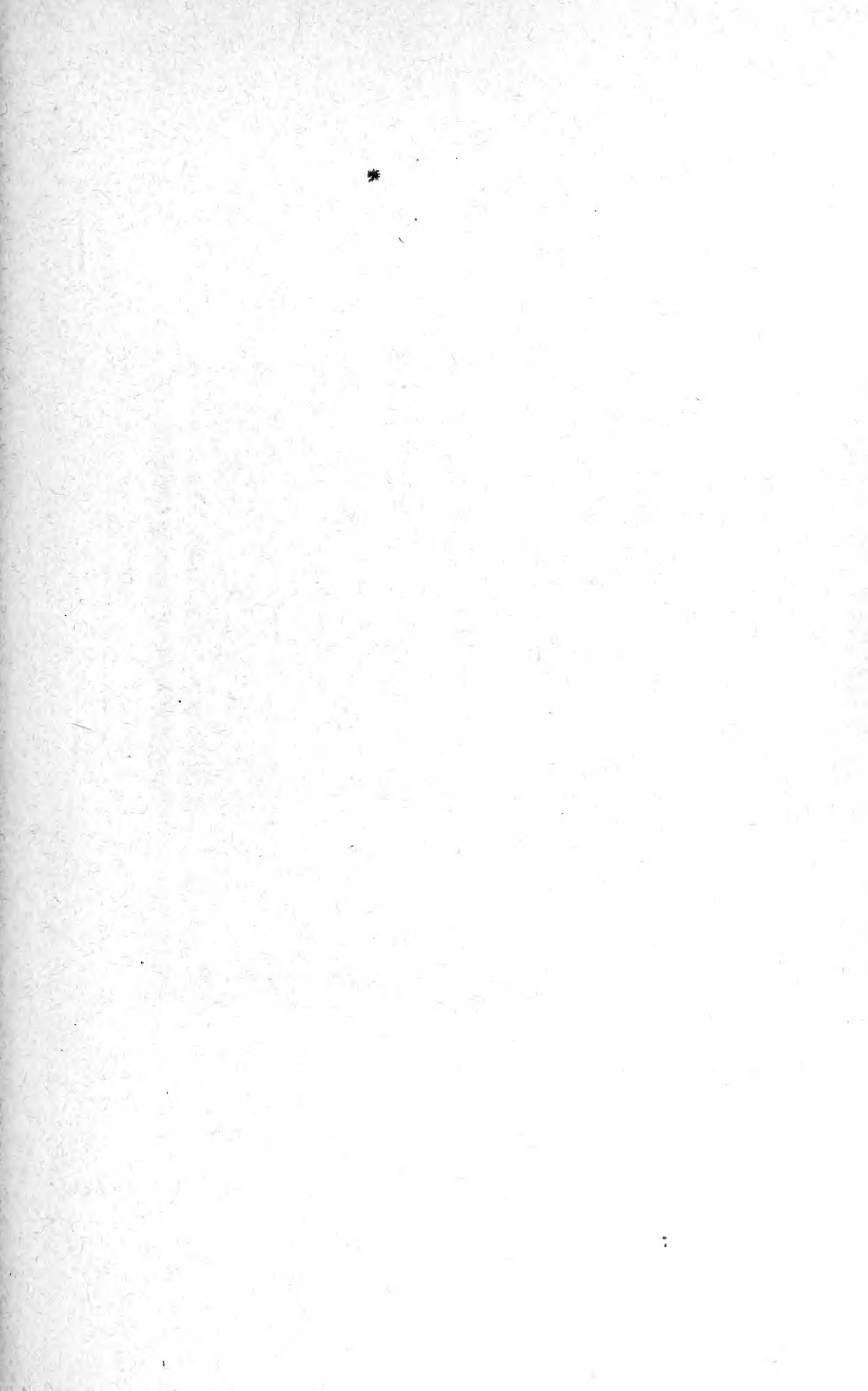
LIBRARY OF  
THE NEW YORK BOTANICAL GARDEN

Given by Dr. N. R. Britton,  
1905

September 1899

R. W. Gibson. Inv.

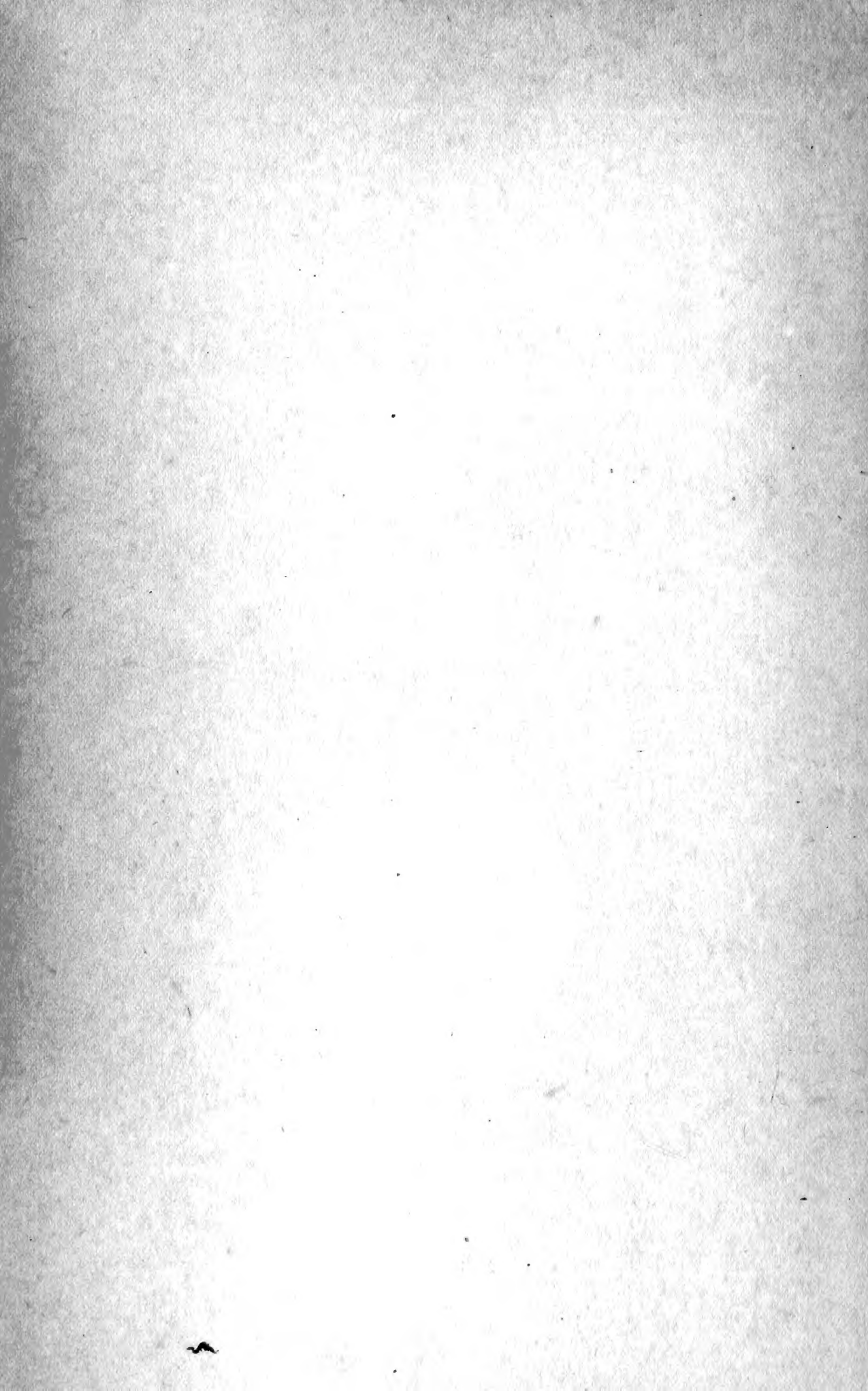












---

ANNALS  
OF THE  
NEW YORK ACADEMY OF SCIENCES,  
LATE  
LYCEUM OF NATURAL HISTORY.

VOLUME VIII. (INDEX.)



NEW YORK :  
PUBLISHED BY THE ACADEMY.  
1896.

---





ANNALS  
OF THE  
NEW YORK ACADEMY OF SCIENCES.



ANNALS  
OF THE  
NEW YORK ACADEMY OF SCIENCES,  
LATE  
LYCEUM OF NATURAL HISTORY.

VOLUME VIII.

---

1893-1895.

---

NEW YORK :  
PUBLISHED BY THE ACADEMY.



.N621

v. 8

1893-95

# OFFICERS OF THE ACADEMY.

1895.

---

*PRESIDENT.*

J. K. REES.

*VICE-PRESIDENTS.*

H. F. OSBORN,

J. J. STEVENSON.

*CORRESPONDING SECRETARY.*

D. S. MARTIN.

*RECORDING SECRETARY.*

J. F. KEMP.

*TREASURER.*

CHAS. F. COX.

*PUBLICATION COMMITTEE.*

J. K. REES,

J. F. KEMP,

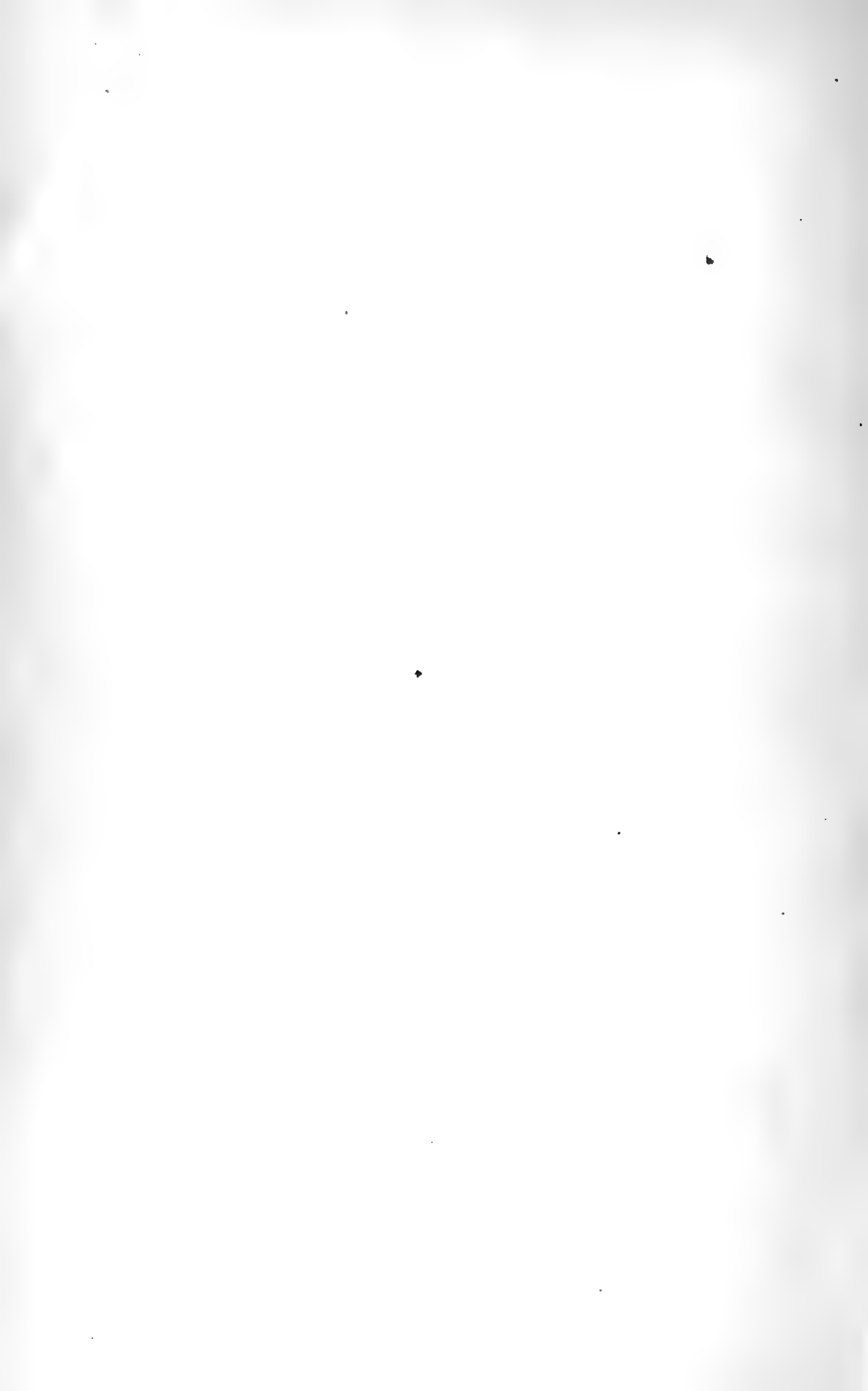
H. F. OSBORN,

N. L. BRITTON,

D. S. MARTIN,

WM. HALLOCK.

THOS. L. CASEY, Editor of Annals.





# CONTENTS OF VOLUME VIII.

BY NATHAN BANKS.

|  | PAGE. |
|--|-------|
| Art. XIV.—The Arachnida of Colorado. . . . . | 417   |

BY THOS. L. CASEY.

|   |     |
|---|-----|
| Art. XV.—Coleopterological Notices, VI. . . . . | 435 |
|---|-----|

BY O. F. COOK AND G. N. COLLINS.

|   |    |
|---|----|
| Art. II.—The Myriapoda Collected by the United States Eclipse Expedition to West Africa, 1889 and 1890. . . . . | 24 |
| Art. VIII.—A Monograph of Seytonotus. . . . .   | 23 |

BY HENRY E. CRAMPTON, JR.

|   |     |
|---|-----|
| Art. V.—Reversal of Cleavage in a Sinistral Gasteropod. . . . . | 167 |
|---|-----|

BY HERMAN S. DAVIS.

|   |     |
|---|-----|
| Art. XI.—The Parallax of $\eta$ Cassiopeiæ, deduced from Rutherford Photographic Measures. . . . .  | 301 |
| Art. XIII.—The Rutherford Photographic Measures of Sixty-two Stars about $\eta$ Cassiopeiæ. . . . . | 381 |

BY HARRISON G. DYAR.

|  |     |
|--|-----|
| Art. VII.—A Classification of Lepidopterous Larvæ. . . . .           | 194 |
| Art. XII.—On Certain Bacteria from the Air of New York City. . . . . | 322 |

BY HARWOOD HUNTINGTON.

|  |     |
|--|-----|
| Art. VI.—Certain New Derivatives in the Aromatic Series. . . . . | 171 |
|--|-----|

BY HAROLD JACOBY.

|   |   |
|---|---|
| Art. I.—The Parallaxes of $\mu$ and $\theta$ Cassiopeiæ, deduced from Rutherford Photographic Measures. . . . . | 1 |
|---|---|

BY ALEXIS A. JULIEN.

|  |    |
|--|----|
| Art. IV.—A Study of the New York Obelisk as a Decayed Boulder. . . . . | 93 |
|--|----|

# OFFICERS OF THE ACADEMY.

1893.

---

President.

H. CARRINGTON BOLTON.

Vice-Presidents.

J. A. ALLEN,

HENRY F. OSBORN.

Corresponding Secretary.

THOMAS L. CASEY.

Recording Secretary.

N. L. BRITTON.

Treasurer.

CHAS. F. COX.

Committee of Publication.

J. A. ALLEN,

N. L. BRITTON,

HAROLD JACOBY,

H. F. OSBORN.

THOS. L. CASEY (EDITOR).

ANNALS  
OF THE  
NEW YORK ACADEMY OF SCIENCES,  
VOLUME VIII.

---

I.—*The Parallaxes of  $\mu$  and  $\theta$  Cassiopeiæ, deduced from  
Rutherford Photographic Measures.*

BY HAROLD JACOBY.

Read Jan. 9, 1893.

THE RUTHERFURD photographic measures of the stars surrounding  $\mu$  Cassiopeiæ are derived from twenty-eight negatives made between 1870 July, and 1873 December. These observations were taken in accordance with RUTHERFURD'S regular plan for securing accurate micrometric measures of star clusters: but in order to combine therewith a determination of parallax, the observations were all made in the months of July, January, and December. There are two impressions upon each negative. A discussion of all the micrometric measures of some fifty-six stars will be published later, the present paper containing those measures only that have been selected for the parallax determination. I have set down in table I. (p. 12) the dates and other details of the several exposures, so far as they are connected with the present purpose. The sidereal time given is the mean of the four instants marking the beginning and ending of the two exposures. The second exposure always began a few seconds after the ending of the first, and the duration of each was six minutes.

Table II. (p. 13) gives a list of the comparison stars employed. The pair  $g, h$ , will not furnish a suitable parallax factor in distance,

but it has been included to secure evidence as to possible variation of scale value with position angle. It is perhaps necessary to remark that I have preferred to base the study of parallax upon measures of distance only. The original plan did not include the pair  $c, d$ ; but the observations of the pair  $c, \theta$ , having produced a discordant result, the pair  $c, d$ , was also computed. From this discordance it has been possible to obtain a value for the parallax of  $\theta$  Cassiopeiæ, a result not anticipated when the reduction of the observations was begun. It is for this reason that the star  $c$  appears twice in table II. The method of computation is the one commonly employed. The two stars of each pair were selected so as to differ approximately  $180^\circ$  in position angle with respect to  $\mu$  Cassiopeiæ. The scale value was then determined for each pair, on each plate, so as to make the *sum* of the distances from  $\mu$  constant. The *difference* of the same distances was then taken as the quantity from whose variation the parallax should appear. This method gives the excess of the parallax of the principal star over the mean of the parallaxes of the two comparison stars.\*

Every observation of distance contained in the RUTHERFURD observation books has been used, the treatment of the observational data being as follows: First, means were taken of the separate pointings of the microscope, each measure of distance depending upon ten independent pointings on  $\mu$  Cassiopeiæ, and ten on the comparison star. The distances thus obtained from the two separate impressions were combined into a single mean depending altogether on 40 pointings, and this mean was then considered as one complete measure. The distances thus obtained are expressed in divisions of the glass scale of the measuring micrometer, one such division being approximately equal to  $28''.01$ . The same unit of measure has generally been employed throughout all the subsequent calculations. The following corrections were then applied:—

1. Correction for division errors. These were taken from the table of corrections determined by ROGERS.†

\* This is of course not strictly true unless the two comparison stars are equidistant from the principal star,—a condition which should always be approximately satisfied. Nor is it possible to deduce the parallax of the principal star with respect to each comparison star separately, since the parallaxes of both comparison stars will always influence the result through the scale value determination.

† Ann. N. Y. Acad. Sci., vol. vi, p. 250.

2. The "tangent correction," due to the photograph being taken on a plane surface. This correction is derived from table IV. A, given in my paper on the RUTHERFURD photographic measures of the stars about  $\beta$  Cygni.\*
3. Correction for refraction, computed according to the method given in my paper on the Pleiades.† Whenever necessary, the higher terms of the refraction were approximately taken into account.
4. Correction for aberration, computed according to the customary Besselian formulæ.‡
5. Correction for the proper motion of  $\mu$  Cassiopeiæ. The observations have been reduced to the epoch 1872.0, using Auwers' proper motion, which is:

$$\Delta\alpha = + 0^s.3860 \qquad \Delta\delta = - 1.''580,$$

corresponding to a motion of  $3''.729$  upon a great circle whose position angle is  $115^\circ 4'$ . Now, in general, if we let:

$\rho$  = the annual proper motion of the principal star on a great circle,

$\alpha$  = the position angle of that great circle at the time  $t_0$ ,

$t$  = the time of observation, expressed in years and fractions of a year. And put:

$$\tau = t - t_0$$

$$S_1 = \cos (\alpha - p)$$

$$S_2 = - \frac{1}{2s} \sin^2 (\alpha - p)$$

$$P_1 = \tau\rho$$

$$P_2 = \tau^2\rho^2$$

then we must add to the observed distances the correction:

$$\Delta s = S_1 P_1 + S_2 P_2.$$

The values of  $S_1$ ,  $S_2$ ,  $P_1$ , and  $P_2$  used in the present paper are given in table III. (p. 13), the unit of measure for  $\rho$  being one division of the glass scale, as already explained. The distances thus completely corrected, are set down in the second and third columns of table IV. (p. 15). The fourth and fifth columns of the same table contain the *sum* of the distances of the two comparison

\* Ann. N. Y. Acad. Sci., vol. vi, p. 340.

† Ibid., pp. 253, *et seq.*

‡ Astron. Untersuch., vol. i, p. 202, *et seq.*



stars from  $\mu$  Cassiopeiæ, and the difference of that sum from an adopted mean given at the foot of the fourth column. In the sixth, seventh, and eighth column are placed the *difference* of the distances as given in the second and third columns; the *scale correction*, which is simply a proportional part of the quantity given in the column "mean *minus* sum"; and finally the *corrected difference*, to be used in forming the parallax equations. The latter equations, together with their solutions, are to be found in table V. (p. 20); and with regard to them I have only to remark that the absolute terms are expressed in units of the second decimal place, equivalent to  $0''.2801$ . The parallax coefficients in the observation equations of table V. are computed by the customary formulæ, as follows:—

Let  $\alpha$ ,  $\delta$ , be the coördinates of  $\mu$  Cassiopeiæ for 1872.

$r$ ,  $\odot$ , be the radius vector, and longitude of the sun;  
and compute—

$$\begin{aligned} g \sin G &= \sin \delta \cos \alpha, & h \sin H &= \sin \delta \sin \alpha, & f \sin F &= h \sin (H + \varepsilon) \\ g \cos G &= \sin \alpha, & h \cos H &= -\cos \delta, & f \cos F &= -\cos \alpha \cos \varepsilon \end{aligned}$$

then if we put:

$$\begin{aligned} S_3 &= f \sin (p + F) \\ S_4 &= g \sin (p + G) \\ P_3 &= -r \sin \odot \\ P_4 &= -r \cos \odot \end{aligned}$$

the parallax coefficient for any one of the equations will be:

$$(S_3 - S'_3) P_3 + (S_4 - S'_4) P_4,$$

where  $S'_3$  and  $S'_4$  refer to the second comparison star of the pair. The corresponding coefficient for the *sum* of the distances of the two comparison stars of any pair is

$$(S_3 + S'_3) P_3 + (S_4 + S'_4) P_4,$$

which I have found sufficiently small to be negligible for all the pairs used in the present research.

The values of  $S_3$ ,  $S_4$ ,  $P_3$ ,  $P_4$ , are found in table III. (p. 13).

Before proceeding to discuss the parallax results, as obtained in table V., attention should be called to table IV. A, which throws some light on the question of variation of scale value. The first five columns of this table give for each plate, and for each pair of stars, that fraction of "mean *minus* sum," from table IV., which

corresponds to a distance of 100 divisions of the scale. It will be seen that this quantity is a measure of the discordance between the scale value for each plate, and the mean scale value for all the plates. Now, by placing these discordances, as derived from pairs of stars differing widely in position angle, side by side, we can at once see whether the scale value varies with position angle, or is really a constant for any given plate. To make this comparison quite rigorous, the adopted mean, from which the quantity "mean *minus* sum" is derived in table IV., ought to be computed from the measures of those plates only, that have impressions of *all* the stars. Accordingly the "adopted means" of table IV. are computed from the measures of plates

|    |    |    |    |
|----|----|----|----|
| 31 | 41 | 47 | 57 |
| 32 | 42 | 48 | 58 |
| 33 | 43 | 49 | 59 |
| 34 | 46 | 50 | 60 |

Except in the case of the pair  $c, d$ , which was subsequently added, as already explained. In this case I have used the actual mean of all the values given in table IV., a circumstance which will not materially affect the evidence furnished by this pair of stars. The pair  $c, \theta$  has not been used, since the parallax of  $\theta$  would tend to render its evidence unreliable. Two things become plain from an inspection of the table. In the first place, there is no decisive evidence of great variations of scale value with position angle. In fact, if we regard as casual the differences from the mean values contained in the sixth column, we find as the average difference without regard to sign,  $\pm 0.0050$ . This would correspond to about  $0''.05$  per  $1000''$ : but it is hardly greater than the necessary uncertainty of observation. In the second place, we see that the scale value depends upon temperature. This latter circumstance, it is almost needless to remark, does not influence the parallax determination, though it will be of importance in the general discussion of all the micrometric measures.

It will therefore be of interest to examine the evidence a little more in detail. In doing this, I have taken into consideration the readings of the focal micrometer, as set down in table I. One revolution of this micrometer is equivalent to  $0.05$  inches, and the arrangement is such that increasing readings of the micrometer

correspond to increasing focal length of the telescope. To calculate the focal length, we have the following:

$$\text{Linear scale value}^* = 0.020859 \text{ inches.}$$

$$\text{Mean angular scale value}^\dagger = 28''.0124$$

from which:

$$\text{Focal length} = 153.59 \text{ inches.}$$

Now putting:

$$f = \text{reading of the focal micrometer for any given plate,}$$

I find from the above focal length and pitch of the micrometer screw that the numbers given in table IV. A require an additional correction of:

$$+0.0325 (f - 7.86)$$

to reduce them to the mean focal reading (7.86). Accordingly, this correction has been applied to the means in the sixth column, thus obtaining the corrected means of the seventh column. From these latter it is possible to discuss the effect of temperature, independently of the focal readings, provided we assume that the zero point of the scale attached to the focal micrometer always retained exactly the same distance from the optical centre of the lens, except as influenced by changes of temperature. Now this assumption can hardly be regarded as altogether justified *a priori* in the case of the RUTHERFURD telescope. I have therefore made two separate least square adjustments of the quantities given in the columns *mean* and *mean corrected*.

Representing these quantities by equations of the form:

$$x + y (t - t_0)$$

where  $t$  is the observed temperature for any plate, and  $t_0$  the mean temperature, I find:

$$\text{Column mean} = - .0027 \pm .00063 - .000372 (t - 58^\circ.4) \\ \pm .000029$$

$$\text{Column mean corr'd} = - .0027 \pm .00057 - .000424 (t - 58^\circ.4) \\ \pm .000027$$

The attached probable errors show that the observations are represented better if we take the readings of the focal micrometer into account. This would seem to justify the assumption of con-

\* ROGERS' determination, Ann. N. Y. Acad. Sci., vol. vi, p. 249.

† The Pleiades result, *ibid.*, p. 270.

stancy in the focal zero point; and I shall therefore adopt the temperature coefficient from the second solution, viz:

$$- 0.000424 \pm 0.000027$$

This coefficient holds good for a distance of 100 divisions of the scale. For one division of the scale it will be:

$$- 0^d.00000424 \pm 0.00000027, \text{ or } - 0''.000119 \pm 0''.000008.$$

The evidence as to the reality of this temperature coefficient seems to be very strong, notwithstanding that the scale values obtained for the Pleiades plates\* did not appear to vary with temperature. In the light of the present evidence we may perhaps be justified in ascribing this to the comparatively small changes of temperature throughout the Pleiades series, and to the fact that the last two Pleiades plates furnish a very discordant scale value, which tends to conceal the smaller temperature effects. No satisfactory explanation of this latter circumstance suggests itself, unless we assume that the glass scale had been removed temporarily from the measuring machine; and that when replaced, it made a small angle with its former position. It seems best, therefore, to disregard the last two Pleiades plates in deducing a definitive scale value. If we do this, the Pleiades series give for the mean scale value  $28''.0138$ , corresponding to a mean temperature of the telescope  $41^{\circ}.6$ , and a mean focal reading  $7.88$ . For a plate having any other temperature ( $t$ ) and focal reading ( $f$ ), we ought therefore to use a scale value computed by the following formula:

$$\text{Scale value} = 28''.0138 - 0''.0090 (f - 7.88) - 0''.000119 (t - 41.6) \quad (a)$$

On the other hand, if we prefer to retain the scale values from the last two Pleiades plates, we should have:

$$\text{Scale value} = 28''.0124 - 0''.0090 (f - 7.87) - 0''.000119 (t - 40.3) \quad (b)$$

The following table shows how these two formulæ represent the observed Pleiades scale values. The numbers in the fourth column are means from the two impressions on the plate.

\* Ann. N. Y. Acad. Sci., vol. vi, p. 271.

| Plate No. | Focus. | Telesc. Temp. | Observed Scale Val. | Computed Scale Val. |            | Residuals, $C - O$ . |            |
|-----------|--------|---------------|---------------------|---------------------|------------|----------------------|------------|
|           |        |               |                     | Form. (a).          | Form. (b). | Form. (a).           | Form. (b). |
| 16        | 7.9    | 35°           | 28.0168             | 28.0144             | 28.0127    | — .0024              | — .0041    |
| 17        | 7.9    | 35            | .0151               | .0144               | .0127      | — .0007              | — .0034    |
| 18        | 8.1    | 27            | .0144               | .0135               | .0137      | — .0009              | — .0007    |
| 19        | 7.78   | 52            | .0122               | .0135               | .0118      | + .0013              | — .0004    |
| 20        | 7.78   | 52            | .0118               | .0135               | .0118      | + .0017              | .0000      |
| 21        | 7.85   | 52            | .0122               | .0129               | .0112      | + .0007              | — .0010    |
| 22        | 7.85   | 40            | .0148               | .0143               | .0126      | — .0005              | — .0022    |
| 23        | 7.85   | 40            | .0132               | .0143               | .0126      | + .0011              | — .0006    |
| 24        | 7.85   | 35            | .0070               | .0149               | .0132      | + .0079              | + .0062    |
| 25        | 7.85   | 35            | .0066               | .0149               | .0132      | + .0083              | + .0066    |

The residuals are not quite satisfactory. I have therefore discussed the Pleiades scale values by means of formula (a), omitting the discordant plates 24 and 25, and find the temperature coefficient :

$$- 0''.000230 \pm 0''.000040.$$

It is further to be remarked, that the residuals from formula (a) are somewhat less than we should get if we left the temperature and focal reading altogether out of consideration.

To complete this part of the subject, it is necessary to examine the evidence of the  $\beta$  Cygni plates.\* For this purpose I selected from the RUTHERFURD  $\beta$  Cygni list four pairs of stars, suitably distributed in position angle. Treating the data exactly as already described for the  $\mu$  Cassiopeiæ plates, gives the temperature coefficient :

$$- 0^d.00000696 \pm 0^d.00000167, \text{ or } - 0''.000195 \pm 0''.000047.$$

The low weight of this result, like that from the Pleiades series, is of course due to the small number of plates used, and to the comparatively slight range of temperature. Assembling the three values obtained, we have for the temperature coefficient :

$$\begin{array}{llll} \mu \text{ Cassiopeiæ} & . & . & - 0''.000119 \pm 0''.000008 \\ \beta \text{ Cygni} & . & . & - 0.000195 \pm 0.000047 \\ \text{Pleiades} & . & . & - 0.000230 \pm 0.000040 \\ \text{Mean by weight} & . & . & - 0.000125 \pm 0.000008 \end{array}$$

The evidence of the  $\beta$  Cygni and Pleiades plates practically does not change the result from the  $\mu$  Cassiopeiæ plates. I am therefore

\* Ann. N. Y. Acad. of Sci., vol. vi, pp. 331, *et seq.*

inclined to regard (*a*) as the best scale value formula deducible from the evidence made available up to the present time. In the case of the  $\beta$  Cygni plates, whose mean focal reading is 7.68, and mean temperature  $68^{\circ}.0$ , this formula gives  $28''.0125$ , which agrees almost exactly with the scale value ( $28''.0124$ ) actually employed in the  $\beta$  Cygni reductions.

Returning now to the results arising from the solution of the equations in table V. (p. 20) we find the following values for  $\pi$ , the parallax, and  $y$ , the correction of the annual proper motion effect. The quantity  $x$ , which is merely the error of the value arbitrarily assumed for the "corrected difference," is here omitted.

| Comp. Stars.          | $\pi$                   | $y$                     | Prob. error<br>one equation.* |
|-----------------------|-------------------------|-------------------------|-------------------------------|
| <i>a</i> and <i>b</i> | $+ 0''.249 \pm 0''.045$ | $- 0''.153 \pm 0''.051$ | $\pm 0''.251$                 |
| <i>c</i> and <i>d</i> | $+ 0''.266 \pm 0''.035$ | $+ 0''.127 \pm 0''.052$ | $\pm 0''.222$                 |
| <i>e</i> and <i>f</i> | $+ 0''.324 \pm 0''.050$ | $- 0''.136 \pm 0''.056$ | $\pm 0''.196$                 |
| <i>c</i> and $\theta$ | $+ 0''.151 \pm 0''.026$ | $- 0''.122 \pm 0''.041$ | $\pm 0''.190$                 |

It will be seen at once that the values of  $\pi$  deduced from the first three pairs agree with each other fully as well as might be expected from their probable errors. The parallax depending on *c* and  $\theta$ , on the other hand, differs widely. We may conclude that this is due to the existence of a sensible parallax belonging to  $\theta$ . If we then depend upon the first three pairs for the parallax of  $\mu$  we shall have, taking the mean by weight :

$$\text{Parallax of } \mu \text{ Cassiopeiæ} = + 0''.275 \pm 0''.024.$$

But if we consider the three determinations as having equal weight, we get for the arithmetical mean, and probable error from the three residuals,  $\pi = + 0''.280 \pm 0''.026$ . Now if we admit the existence of a sensible parallax for  $\theta$ , the result obtained above from the comparison stars *c* and  $\theta$  is not the parallax of  $\mu$ , but a quantity which is very nearly equal to :

$$\pi_{\mu} - \frac{1}{2} \pi_{\theta} \left( 1 - \frac{s_c - s_{\theta}}{s_c + s_{\theta}} \right)$$

where:  $\pi_{\mu}$  and  $\pi_{\theta}$  are the parallaxes of  $\mu$  and  $\theta$ ,

$s_c$  and  $s_{\theta}$  are the distances of *c* and  $\theta$  from  $\mu$ .

\* This is the probable error of the *difference* of two distances as measured on one plate. But as there are two impressions on each plate, it may also be regarded as the probable error of one complete measure of distance from a single impression.



corresponding to a motion of  $3''.784$  upon a great circle whose position angle is  $113^\circ 59'$ . The following are therefore the several values of the proper motion, to be compared with each other:

|                                | $\rho$    | $\chi$          | $\Delta\alpha$ | $\Delta\delta$ |
|--------------------------------|-----------|-----------------|----------------|----------------|
| As just obtained . . . . .     | $3''.784$ | $113^\circ 59'$ | $+ 0.3950$     | $- 1''.538$    |
| AUWERS'-BRAD. (1810), as used  |           |                 |                |                |
| in the present paper . . . .   | $3.729$   | $115 \quad 4$   | $+ 0.3860$     | $- 1.580$      |
| AUWERS'-BRAD., reduced to 1872 | $3.729$   | $115 \quad 13$  | $+ 0.3854$     | $- 1.589$      |

When we compare the parallax of  $\mu$  Cassiopeiæ derived in the present paper, with the work of other observatories, we find large discordances. Thus the Oxford photographic result is only about  $0''.036 \pm 0''.018$ , while the RUTHERFURD plates give  $0''.249 \pm 0''.045$  from the same pair of comparison stars. On the other hand, STRUVE has obtained  $0''.251 \pm 0''.075$  from distance measures, and from position angles  $0''.425 \pm 0''.072$ . It is therefore plain that the photographic method of determining parallaxes cannot be regarded as free from systematic error. An examination of the equations of table V. shows that negative parallax coefficients invariably occur in the case of plates exposed at eastern hour angles. This circumstance, which arises from the inconvenience of observing after midnight, may possibly produce systematic error. But the evidence of the scale value table (IV. A) is against this supposition, as is also the approximate equality of the parallaxes obtained from pairs of comparison stars having widely different distances from  $\mu$ .

In conclusion, the results here deduced may be summed up as follows:—

|                                 |                   |
|---------------------------------|-------------------|
| Parallax of $\mu$ Cassiopeiæ    | $0.275 \pm 0.024$ |
| Parallax of $\theta$ Cassiopeiæ | $0.232 \pm 0.067$ |

But the above probable errors must not be taken as reliable estimates of uncertainty, since a comparison with the work of other astronomers seems to indicate the possibility of systematic error. But if we are willing to accept the above results, it is perhaps allowable to speculate upon  $\mu$  and  $\theta$  Cassiopeiæ as a system remotely resembling that of 61 Cygni. The indication of equality of parallaxes furnished by BESSEL's observations, and the slight evidence of variation in the proper motion of  $\mu$  Cassiopeiæ obtained from the equations on p. 10, would almost seem to favor such an idea.



TABLE I.—GENERAL DATA,  
OBSERVATORY OF L. M. RUTHERFURD, NEW YORK.

Lat. =  $40^{\circ} 43' 48''.5$ , Long. =  $4^{\text{h}} 55^{\text{m}} 56^{\text{s}}.62$  W.

| Plate No. | Date.        | Sidereal Time.                                  | Hour Angle.                                     | Zen. Dist. | Parall. Angle. | Ext. Temp. | Focal Mic'r. |
|-----------|--------------|---|---|------------|----------------|------------|--------------|
| 31        | 1870 July 23 | 20 <sup>h</sup> 47 <sup>m</sup> 45 <sup>s</sup> | 19 <sup>h</sup> 47 <sup>m</sup> 59 <sup>s</sup> | 43.05      | — 81.46        | 79°        | 7.7          |
| 32        | 1870 July 23 | 21 56 35  | 20 56 49  | 33.04      | — 95.07        | 79         | 7.7          |
| 33        | 1870 July 30 | 20 15 15  | 19 15 29  | 47.70      | — 75.78        | 70         | 7.9          |
| 34        | 1870 July 30 | 20 43 35  | 19 43 49  | 43.67      | — 80.70        | 70         | 7.9          |
| 36        | 1871 July 10 | 20 39 38  | 19 39 52  | 44.22      | — 80.00        | 76         | 7.9          |
| 37        | 1871 July 10 | 21 20 8   | 20 20 22  | 38.36      | — 87.51        | 76         | 7.9          |
| 38        | 1871 July 23 | 20 30 5   | 19 30 19  | 45.60      | — 78.33        | 65         | 8.1          |
| 40        | 1872 Jan. 2  | 4 5 30  | 3 5 44  | 33.41      | + 94.50        | 30         | 7.9          |
| 41        | 1872 Jan. 2  | 5 4 28  | 4 4 42  | 42.01      | + 82.77        | 30         | 7.9          |
| 42        | 1872 Jan. 5  | 2 23 0  | 1 23 14   | 19.39      | + 125.83       | 35         | 7.9          |
| 43        | 1872 July 19 | 21 3 2  | 20 3 16   | 40.85      | — 84.24        | 71         | 7.9          |
| 44        | 1872 July 19 | 21 38 52  | 20 39 6   | 35.63      | — 91.26        | 71         | 7.9          |
| 45        | 1872 July 20 | 21 13 8   | 20 13 22  | 39.38      | — 86.14        | 73         | 7.9          |
| 46        | 1872 July 20 | 21 49 42  | 20 49 56  | 34.04      | — 93.56        | 73         | 7.9          |
| 47        | 1873 Jan. 6  | 3 26 32   | 2 26 46   | 27.80      | + 103.96       | 26         | 7.9          |
| 48        | 1873 Jan. 9  | 4 6 28  | 3 6 42  | 33.55      | + 94.29        | 24         | 7.9          |
| 49        | 1873 Jan. 9  | 4 40 2  | 3 40 16   | 38.45      | + 87.37        | 24         | 7.9          |
| 50        | 1873 Jan. 10 | 3 32 2  | 2 32 16   | 28.59      | + 102.50       | 21         | 7.95         |
| 51        | 1873 July 15 | 21 46 42  | 20 46 56  | 34.49      | — 92.91        | 75         | 7.75         |
| 52        | 1873 July 21 | 20 52 52  | 19 53 6   | 42.32      | — 82.37        | 69         | 7.8          |
| 53        | 1873 July 21 | 21 27 52  | 20 28 6   | 37.23      | — 89.03        | 69         | 7.8          |
| 54        | 1873 July 23 | 19 49 48  | 18 50 2   | 51.26      | — 71.50        | 75         | 7.75         |
| 55        | 1873 July 23 | 20 33 8   | 19 33 22  | 45.16      | — 78.85        | 75         | 7.75         |
| 56        | 1873 July 23 | 21 8 58   | 20 9 12   | 39.98      | — 85.35        | 75         | 7.75         |
| 57        | 1873 Dec. 18 | 4 14 18   | 3 14 32   | 34.69      | + 92.60        | 41         | 7.8          |
| 58        | 1873 Dec. 18 | 4 50 18   | 3 50 32   | 39.95      | + 85.40        | 41         | 7.8          |
| 59        | 1873 Dec. 21 | 2 36 38   | 1 36 52   | 21.06      | + 120.12       | 27         | 7.9          |
| 60        | 1873 Dec. 21 | 3 10 12   | 2 10 26   | 25.52      | + 108.61       | 27         | 7.9          |

TABLE II.—COMPARISON STARS.

| Designation<br>of Comp.<br>Star. | No. in<br>A. G. Cat.<br>Cambr. U. S. | Mag. in<br>A. G. Cat. | Approx. Position, Referred to $\mu$ Cass. |           |
|----------------------------------|--------------------------------------|-----------------------|---|-----------|
|                                  |                                      |                       | Distance.                                 | Pos. Ang. |
| <i>a</i>                         | 517                                  | 8.8                   | 762''                                     | 31° 14''  |
| <i>b</i>                         | 509                                  | 8.9                   | 1358                                      | 199 7     |
| <i>c</i>                         | 485                                  | 8.8                   | 1705                                      | 271 48    |
| <i>d</i>                         |                                      |                       | 2442                                      | 86 31     |
| <i>e</i>                         | 527                                  | 7.5                   | 1529                                      | 123 40    |
| <i>f</i>                         | 490                                  | 8.9                   | 1627                                      | 281 39    |
| <i>g</i>                         | 519                                  | 7.1                   | 2727                                      | 169 7     |
| <i>h</i>                         | 496                                  | 8.2                   | 3175                                      | 335 10    |
| <i>c</i>                         | 485                                  | 8.8                   | 1705                                      | 271 48    |
| $\theta$                         | 541                                  | 5.5                   | 1966                                      | 70 46     |

TABLE III.—PROPER MOTION AND PARALLAX.

See pages 3 and 4.

| Star.    | Proper Motion. |         | Parallax. |         |
|----------|----------------|---------|-----------|---------|
|          | $S_1$ .        | $S_2$ . | $S_3$ .   | $S_4$ . |
| <i>a</i> | +0.107         | —0.018  | —0.493    | +0.804  |
| <i>b</i> | +0.104         | —0.010  | +0.328    | —0.826  |
| <i>c</i> | —0.919         | —0.001  | +0.883    | —0.233  |
| <i>d</i> | +0.878         | —0.001  | —0.886    | +0.305  |
| <i>e</i> | +0.989         | 0.000   | —0.714    | —0.220  |
| <i>f</i> | —0.973         | 0.000   | +0.859    | —0.094  |
| <i>g</i> | +0.587         | —0.003  | —0.128    | —0.722  |
| <i>h</i> | —0.765         | —0.002  | +0.364    | +0.604  |
| $\theta$ | +0.716         | —0.003  | —0.849    | +0.502  |

(Continued on the next page.)

TABLE III. (*continued*).—PROPER MOTION AND PARALLAX.

| Plate No. | Proper Motion. |         |        | Parallax. |        |
|-----------|----------------|---------|--------|-----------|--------|
|           | $t-1872.0$     | $P_1$   | $P_2$  | $P_3$     | $P_4$  |
| 31        | —1.440         | —0.1917 | +0.037 | —0.872    | +0.521 |
| 32        | —1.440         | —0.1917 | +0.037 | —0.871    | +0.522 |
| 33        | —1.420         | —0.1891 | +0.036 | —0.805    | +0.618 |
| 34        | —1.420         | —0.1891 | +0.036 | —0.805    | +0.618 |
| 36        | —0.476         | —0.0634 | +0.004 | —0.965    | +0.319 |
| 37        | —0.476         | —0.0634 | +0.004 | —0.965    | +0.319 |
| 38        | —0.440         | —0.0586 | +0.004 | —0.894    | +0.518 |
| 40        | +0.006         | +0.0008 | 0.000  | +0.962    | —0.202 |
| 41        | +0.006         | +0.0008 | 0.000  | +0.962    | —0.203 |
| 42        | +0.013         | +0.0017 | 0.000  | +0.951    | —0.252 |
| 43        | +0.551         | +0.0734 | +0.005 | —0.901    | +0.470 |
| 44        | +0.551         | +0.0734 | +0.005 | —0.900    | +0.470 |
| 45        | +0.554         | +0.0738 | +0.006 | —0.893    | +0.485 |
| 46        | +0.554         | +0.0738 | +0.006 | —0.892    | +0.486 |
| 47        | +1.019         | +0.1356 | +0.018 | +0.942    | —0.282 |
| 48        | +1.027         | +0.1367 | +0.019 | +0.926    | —0.332 |
| 49        | +1.027         | +0.1367 | +0.019 | +0.925    | —0.333 |
| 50        | +1.029         | +0.1370 | +0.019 | +0.920    | —0.348 |
| 51        | +1.539         | +0.2049 | +0.042 | —0.932    | +0.406 |
| 52        | +1.556         | +0.2072 | +0.043 | —0.886    | +0.496 |
| 53        | +1.556         | +0.2072 | +0.043 | —0.886    | +0.496 |
| 54        | +1.561         | +0.2078 | +0.043 | —0.870    | +0.524 |
| 55        | +1.561         | +0.2078 | +0.043 | —0.870    | +0.525 |
| 56        | +1.561         | +0.2078 | +0.043 | —0.869    | +0.525 |
| 57        | +1.966         | +0.2618 | +0.069 | +0.983    | +0.049 |
| 58        | +1.966         | +0.2618 | +0.069 | +0.983    | +0.048 |
| 59        | +1.974         | +0.2628 | +0.069 | +0.984    | —0.002 |
| 60        | +1.974         | +0.2628 | +0.069 | +0.984    | —0.003 |

TABLE IV.—OBSERVATIONAL DATA.

COMPARISON STARS *a* AND *b*.

| Plate No.    | Distance.       |                 | Sum.<br><i>b</i> + <i>a</i> . | Mean<br><i>Minus</i> Sum. | Difference.<br><i>b</i> — <i>a</i> . | Scale Corr. | Corrected<br>Difference. |
|--------------|-----------------|-----------------|-------------------------------|---------------------------|--------------------------------------|-------------|--------------------------|
|              | Star <i>a</i> . | Star <i>b</i> . |                               |                           |                                      |             |                          |
| 31           | 27.1737         | 48.5528         | 75.7265                       | — .0031                   | 21.3791                              | — .0009     | 21.3782                  |
| 32           | .1789           | .5588           | .7377                         | — .0143                   | .3799                                | — .0040     | .3759                    |
| 33           | .1684           | .5604           | .7288                         | — .0054                   | .3920                                | — .0015     | .3905                    |
| 34           | .1717           | .5548           | .7265                         | — .0031                   | .3831                                | — .0009     | .3822                    |
| 36           | .1770           | .5562           | .7332                         | — .0098                   | .3792                                | — .0028     | .3764                    |
| 37           | .1761           | .5617           | .7378                         | — .0144                   | .3856                                | — .0041     | .3815                    |
| 38           | .1712           | .5669           | .7381                         | — .0147                   | .3957                                | — .0041     | .3916                    |
| 40           | .1898           | .5277           | .7175                         | + .0059                   | .3379                                | + .0017     | .3396                    |
| 41           | .1909           | .5313           | .7222                         | + .0012                   | .3404                                | + .0003     | .3407                    |
| 42           | .1742           | .5485           | .7227                         | + .0007                   | .3743                                | + .0002     | .3745                    |
| 43           | .1667           | .5547           | .7214                         | + .0020                   | .3880                                | + .0006     | .3886                    |
| 45           | .1658           | .5579           | .7237                         | — .0003                   | .3921                                | — .0001     | .3920                    |
| 46           | .1710           | .5645           | .7355                         | — .0121                   | .3935                                | — .0034     | .3901                    |
| 47           | .1795           | .5336           | .7131                         | + .0103                   | .3541                                | + .0029     | .3570                    |
| 48           | .1813           | .5269           | .7082                         | + .0152                   | .3456                                | + .0043     | .3499                    |
| 49           | .1821           | .5464           | .7285                         | — .0051                   | .3643                                | — .0014     | .3629                    |
| 50           | .1758           | .5416           | .7174                         | + .0060                   | .3658                                | + .0017     | .3675                    |
| 51           | .1701           | .5614           | .7315                         | — .0081                   | .3913                                | — .0023     | .3890                    |
| 52           | .1749           | .5600           | .7349                         | — .0115                   | .3851                                | — .0032     | .3819                    |
| 53           | .1829           | .5474           | .7303                         | — .0069                   | .3645                                | — .0019     | .3626                    |
| 57           | .1677           | .5488           | .7165                         | + .0069                   | .3811                                | + .0019     | .3830                    |
| 58           | .1626           | .5519           | .7145                         | + .0089                   | .3893                                | + .0025     | .3918                    |
| 59           | .1661           | .5631           | .7292                         | — .0058                   | .3970                                | — .0016     | .3954                    |
| 60           | .1693           | .5569           | .7262                         | — .0028                   | .3876                                | — .0008     | .3868                    |
| Adopted mean |                 |                 | 75.7234                       | Assumed value 21.3800     |                                      |             |                          |

TABLE IV.—OBSERVATIONAL DATA.  
COMPARISON STARS *c* AND *d*.

| Plate No.    | Distance.      |                | Sum.<br><i>d + c.</i> | Mean<br><i>Minus Sum.</i> | Difference.<br><i>d - c.</i> | Scale Corr. | Corrected<br>Difference. |
|--------------|----------------|----------------|-----------------------|---------------------------|------------------------------|-------------|--------------------------|
|              | Star <i>c.</i> | Star <i>d.</i> |                       |                           |                              |             |                          |
| 31           | 60.9758        | 87.2109        | 148.1867              | — .0220                   | 26.2351                      | — .0039     | 26.2312                  |
| 32           | .9712          | .2026          | .1738                 | — .0091                   | .2314                        | — .0016     | .2298                    |
| 33           | .9859          | .1947          | .1806                 | — .0159                   | .2088                        | — .0028     | .2060                    |
| 34           | .9747          | .2106          | .1853                 | — .0206                   | .2359                        | — .0036     | .2323                    |
| 38           | .9745          | .1943          | .1688                 | — .0041                   | .2198                        | — .0007     | .2191                    |
| 40           | .9421          | .2035          | .1456                 | + .0191                   | .2614                        | + .0034     | .2648                    |
| 42           | .9594          | .2009          | .1603                 | + .0044                   | .2415                        | + .0008     | .2423                    |
| 45           | .9823          | .1993          | .1816                 | — .0169                   | .2170                        | — .0030     | .2140                    |
| 46           | .9816          | .1944          | .1760                 | — .0113                   | .2128                        | — .0020     | .2108                    |
| 47           | .9436          | .2063          | .1499                 | + .0148                   | .2627                        | + .0026     | .2653                    |
| 48           | .9381          | .1927          | .1308                 | + .0339                   | .2546                        | + .0060     | .2606                    |
| 50           | .9510          | .2051          | .1561                 | + .0086                   | .2541                        | + .0015     | .2556                    |
| 51           | .9719          | .1870          | .1589                 | + .0058                   | .2151                        | + .0010     | .2161                    |
| 53           | .9773          | .2060          | .1833                 | — .0186                   | .2287                        | — .0033     | .2254                    |
| 58           | .9630          | .1984          | .1614                 | + .0033                   | .2354                        | + .0006     | .2360                    |
| 59           | .9538          | .1907          | .1445                 | + .0202                   | .2369                        | + .0036     | .2405                    |
| 60           | .9671          | .1886          | .1557                 | + .0090                   | .2215                        | + .0016     | .2231                    |
| Adopted mean |                |                | 148.1647              | Assumed value 26.2300     |                              |             |                          |

TABLE IV.—OBSERVATIONAL DATA.  
COMPARISON STARS *e* AND *f*.

| Plate No.    | Distance.      |                | Sum.<br><i>f + e.</i> | Mean<br><i>Minus Sum.</i> | Difference.<br><i>f - e.</i> | Scale Corr. | Corrected<br>Difference. |
|--------------|----------------|----------------|-----------------------|---------------------------|------------------------------|-------------|--------------------------|
|              | Star <i>e.</i> | Star <i>f.</i> |                       |                           |                              |             |                          |
| 31           | 54.6020        | 58.0915        | 112.6935              | — .0184                   | 3.4895                       | — .0006     | 3.4889                   |
| 32           | .5939          | .0871          | .6810                 | — .0059                   | .4932                        | — .0002     | .4930                    |
| 33           | .5918          | .0971          | .6889                 | — .0138                   | .5053                        | — .0004     | .5049                    |
| 34           | .6014          | .0910          | .6924                 | — .0173                   | .4896                        | — .0005     | .4891                    |
| 41           | .5952          | .0698          | .6650                 | + .0101                   | .4746                        | + .0003     | .4749                    |
| 42           | .5964          | .0679          | .6643                 | + .0108                   | .4715                        | + .0003     | .4718                    |
| 43           | .6021          | .1033          | .7054                 | — .0303                   | .5012                        | — .0009     | .5003                    |
| 44           | .5948          | .1015          | .6963                 | — .0212                   | .5067                        | — .0007     | .5060                    |
| 46           | .6004          | .1019          | .7023                 | — .0272                   | .5015                        | — .0008     | .5007                    |
| 47           | .5890          | .0545          | .6435                 | + .0316                   | .4655                        | + .0010     | .4665                    |
| 48           | .5979          | .0596          | .6575                 | + .0176                   | .4617                        | + .0005     | .4622                    |
| 49           | .5966          | .0524          | .6490                 | + .0261                   | .4558                        | + .0008     | .4566                    |
| 50           | .5950          | .0688          | .6638                 | + .0113                   | .4738                        | + .0004     | .4742                    |
| 57           | .5993          | .0723          | .6716                 | + .0035                   | .4730                        | + .0001     | .4731                    |
| 58           | .5886          | .0818          | .6704                 | + .0047                   | .4932                        | + .0001     | .4933                    |
| 59           | .5998          | .0672          | .6670                 | + .0081                   | .4674                        | + .0003     | .4677                    |
| 60           | .5949          | .0915          | .6864                 | — .0113                   | .4966                        | — .0004     | .4962                    |
| Adopted mean |                |                | 112.6751              | Assumed value 3.4900      |                              |             |                          |

TABLE IV.—OBSERVATIONAL DATA.

COMPARISON STARS  $g$  AND  $h$ .

(Not used for parallax.)

| Plate<br>No. | Distance.  |            | Sum.<br>$h + g$ . | Mean<br>Minus Sum. | Difference.<br>$h - g$ . |
|--------------|------------|------------|-------------------|--------------------|--------------------------|
|              | Star $g$ . | Star $h$ . |                   |                    |                          |
| 31           | 97.3819    | 113.4035   | 210.7854          | — .0203            | 16.0216                  |
| 32           | .3825      | .4086      | .7911             | — .0260            | .0261                    |
| 33           | .3743      | .4116      | .7859             | — .0208            | .0373                    |
| 34           | .3724      | .4034      | .7758             | — .0107            | .0310                    |
| 36           | .3768      | .3904      | .7672             | — .0021            | .0136                    |
| 38           | .3785      | .3947      | .7732             | — .0081            | .0162                    |
| 40           | .3575      | .3771      | .7346             | + .0305            | .0196                    |
| 41           | .3647      | .3764      | .7411             | + .0240            | .0117                    |
| 42           | .3709      | .3894      | .7603             | + .0048            | .0185                    |
| 43           | .3753      | .4074      | .7827             | — .0176            | .0321                    |
| 44           | .3747      | .4063      | .7810             | — .0159            | .0316                    |
| 45           | .3677      | .4046      | .7723             | — .0072            | .0369                    |
| 46           | .3778      | .4027      | .7805             | — .0154            | .0249                    |
| 47           | .3641      | .3891      | .7532             | + .0119            | .0250                    |
| 48           | .3607      | .3899      | .7506             | + .0145            | .0292                    |
| 49           | .3604      | .3891      | .7495             | + .0156            | .0287                    |
| 50           | .3613      | .3870      | .7483             | + .0168            | .0257                    |
| 51           | .3724      | .4023      | .7747             | — .0096            | .0299                    |
| 53           | .3728      | .4016      | .7744             | — .0093            | .0288                    |
| 54           | .3787      | .3942      | .7729             | — .0078            | .0155                    |
| 55           | .3705      | .3968      | .7673             | — .0022            | .0263                    |
| 56           | .3716      | .4045      | .7761             | — .0110            | .0329                    |
| 57           | .3656      | .3876      | .7532             | + .0119            | .0220                    |
| 58           | .3696      | .3853      | .7549             | + .0102            | .0157                    |
| 59           | .3777      | .3925      | .7702             | — .0051            | .0148                    |
| 60           | .3684      | .3899      | .7583             | + .0068            | .0215                    |
| Adopted mean |            |            | 210.7651          |                    |                          |

TABLE IV.—OBSERVATIONAL DATA.

COMPARISON STARS *c* AND *θ*.

| Plate No.    | Distance.       |                 | Sum.<br>$\theta + c$ . | Mean<br>Minus Sum.   | Difference.<br>$\theta - c$ . | Scale Corr. | Corrected<br>Difference. |
|--------------|-----------------|-----------------|------------------------|----------------------|-------------------------------|-------------|--------------------------|
|              | Star <i>c</i> . | Star $\theta$ . |                        |                      |                               |             |                          |
| 31           | 60.9758         | 70.2500         | 131.2258               | — .0066              | 9.2742                        | — .0005     | 9.2737                   |
| 32           | .9712           | .2431           | .2143                  | + .0049              | .2719                         | + .0003     | .2722                    |
| 33           | .9859           | .2520           | .2379                  | — .0187              | .2661                         | — .0013     | .2648                    |
| 34           | .9747           | .2523           | .2270                  | — .0078              | .2776                         | — .0000     | .2770                    |
| 38           | .9745           | .2502           | .2247                  | — .0055              | .2757                         | — .0004     | .2753                    |
| 40           | .9421           | .2431           | .1852                  | + .0340              | .3010                         | + .0024     | .3034                    |
| 41           | .9472           | .2383           | .1855                  | + .0337              | .2911                         | + .0024     | .2935                    |
| 42           | .9594           | .2491           | .2085                  | + .0107              | .2897                         | + .0008     | .2905                    |
| 43           | .9825           | .2687           | .2512                  | — .0320              | .2862                         | — .0023     | .2839                    |
| 44           | 61.0002         | .2588           | .2590                  | — .0398              | .2586                         | — .0028     | .2558                    |
| 45           | 60.9823         | .2618           | .2441                  | — .0249              | .2795                         | — .0018     | .2777                    |
| 46           | .9816           | .2765           | .2581                  | — .0389              | .2949                         | — .0028     | .2921                    |
| 47           | .9436           | .2494           | .1930                  | + .0262              | .3058                         | + .0019     | .3077                    |
| 48           | .9381           | .2580           | .1961                  | + .0231              | .3199                         | + .0016     | .3215                    |
| 49           | .9540           | .2492           | .2032                  | + .0160              | .2952                         | + .0011     | .2963                    |
| 50           | .9510           | .2590           | .2100                  | + .0092              | .3080                         | + .0007     | .3087                    |
| 51           | .9719           | .2666           | .2385                  | — .0193              | .2947                         | — .0014     | .2933                    |
| 53           | .9773           | .2672           | .2445                  | — .0253              | .2899                         | — .0018     | .2881                    |
| 57           | .9613           | .2699           | .2312                  | — .0120              | .3086                         | — .0009     | .3077                    |
| 58           | .9630           | .2615           | .2245                  | — .0053              | .2985                         | — .0004     | .2981                    |
| 59           | .9538           | .2620           | .2158                  | + .0034              | .3082                         | + .0002     | .3084                    |
| 60           | .9671           | .2574           | .2245                  | — .0053              | .2903                         | — .0004     | .2899                    |
| Adopted mean |                 |                 | 131.2192               | Assumed value 9.2900 |                               |             |                          |

TABLE IV. A.—VARIATION OF SCALE VALUE.

See page 4.

| Plate No. | Comp. Stars and their Position Angles. |                                     |                                      |                                      | Mean.   | Mean Corr'd. | Temp. of Telesc. |
|-----------|--|-------------------------------------|--------------------------------------|--------------------------------------|---------|--------------|------------------|
|           | <i>a</i> and <i>b</i> .<br>31° 199°    | <i>c</i> and <i>d</i> .<br>272° 87° | <i>e</i> and <i>f</i> .<br>124° 282° | <i>g</i> and <i>h</i> .<br>169° 335° |         |              |                  |
| 31        | — .0041                                | — .0149                             | — .0163                              | — .0096                              | — .0112 | — .0164      | 83°              |
| 32        | — .0189                                | — .0062                             | — .0052                              | — .0123                              | — .0107 | — .0159      | 83               |
| 33        | — .0071                                | — .0107                             | — .0122                              | — .0099                              | — .0100 | — .0087      | 73               |
| 34        | — .0041                                | — .0139                             | — .0153                              | — .0051                              | — .0096 | — .0083      | 73               |
| 36        | — .0129                                |                                     |                                      | — .0010                              | — .0070 | — .0057      | 75               |
| 37        | — .0190                                |                                     |                                      |                                      | — .0190 | — .0177      | 78               |
| 38        | — .0194                                | — .0028                             |                                      | — .0038                              | — .0087 | — .0009      | 68               |
| 40        | + .0078                                | + .0129                             |                                      | + .0145                              | + .0117 | + .0130      | 34               |
| 41        | + .0016                                |                                     | + .0089                              | + .0114                              | + .0073 | + .0086      | 34               |
| 42        | + .0009                                | + .0030                             | + .0096                              | + .0023                              | + .0040 | + .0053      | 36               |
| 43        | + .0026                                |                                     | — .0268                              | — .0083                              | — .0108 | — .0095      | 73               |
| 44        |  |                                     | — .0188                              | — .0075                              | — .0132 | — .0119      | 73               |
| 45        | — .0004                                | — .0114                             | — .0241                              | — .0034                              | — .0098 | — .0085      | 75               |
| 46        | — .0160                                | — .0076                             |                                      | — .0073                              | — .0103 | — .0090      | 75               |
| 47        | + .0136                                | + .0100                             | + .0280                              | + .0056                              | + .0143 | + .0156      | 28               |
| 48        | + .0201                                | + .0229                             | + .0156                              | + .0069                              | + .0164 | + .0177      | 27               |
| 49        | — .0067                                |                                     | + .0231                              | + .0074                              | + .0079 | + .0092      | 27               |
| 50        | + .0079                                | + .0058                             | + .0100                              | + .0080                              | + .0079 | + .0108      | 23               |
| 51        | — .0107                                | + .0039                             |                                      | — .0046                              | — .0038 | — .0074      | 78               |
| 52        | — .0152                                |                                     |                                      |                                      | — .0152 | — .0172      | 70               |
| 53        | — .0091                                | — .0126                             |                                      | — .0044                              | — .0087 | — .0107      | 70               |
| 54        |  |                                     |                                      | — .0037                              | — .0037 | — .0073      | 78               |
| 55        |  |                                     |                                      | — .0010                              | — .0010 | — .0046      | 78               |
| 56        |  |                                     |                                      | — .0052                              | — .0052 | — .0088      | 78               |
| 57        | + .0091                                |                                     | + .0031                              | + .0056                              | + .0059 | + .0039      | 43               |
| 58        | + .0117                                | + .0022                             | + .0042                              | + .0048                              | + .0057 | + .0037      | 43               |
| 59        | — .0077                                | + .0137                             | + .0072                              | — .0024                              | + .0027 | + .0040      | 30               |
| 60        | — .0037                                | + .0061                             | — .0100                              | + .0032                              | — .0011 | + .0002      | 30               |



TABLE V.—PARALLAX EQUATIONS.

COMPARISON STARS *a* AND *b*.

| Plate. |               |                |                |       |     | <i>v</i> .           |
|--------|---------------|----------------|----------------|-------|-----|----------------------|
| 31     | 1.00 <i>x</i> | —1.44 <i>y</i> | —1.57 <i>π</i> | —0.18 | = 0 | +0.14                |
| 32     | 1.00          | —1.44          | —1.57          | —0.41 | = 0 | —0.09                |
| 33     | 1.00          | —1.42          | —1.67          | +1.05 | = 0 | +1.29                |
| 34     | 1.00          | —1.42          | —1.67          | +0.22 | = 0 | +0.46                |
| 36     | 1.00          | —0.48          | —1.31          | —0.36 | = 0 | —0.95                |
| 37     | 1.00          | —0.48          | —1.31          | +0.15 | = 0 | —0.44                |
| 38     | 1.00          | —0.44          | —1.57          | +1.16 | = 0 | +0.32                |
| 40     | 1.00          | +0.01          | +1.12          | —4.04 | = 0 | —2.12                |
| 41     | 1.00          | +0.01          | +1.12          | —3.93 | = 0 | —2.01                |
| 42     | 1.00          | +0.01          | +1.19          | —0.55 | = 0 | +1.43                |
| 43     | 1.00          | +0.55          | —1.50          | +0.86 | = 0 | +0.15                |
| 45     | 1.00          | +0.55          | —1.52          | +1.20 | = 0 | +0.48                |
| 46     | 1.00          | +0.55          | —1.52          | +1.01 | = 0 | +0.29                |
| 47     | 1.00          | +1.02          | +1.23          | —2.30 | = 0 | —0.83                |
| 48     | 1.00          | +1.03          | +1.30          | —3.01 | = 0 | —1.49                |
| 49     | 1.00          | +1.03          | +1.30          | —1.71 | = 0 | —0.19                |
| 50     | 1.00          | +1.03          | +1.33          | —1.25 | = 0 | +0.30                |
| 51     | 1.00          | +1.54          | —1.43          | +0.90 | = 0 | —0.28                |
| 52     | 1.00          | +1.56          | —1.54          | +0.19 | = 0 | —1.10                |
| 53     | 1.00          | +1.56          | —1.54          | —1.74 | = 0 | —3.03                |
| 57     | 1.00          | +1.97          | +0.73          | +0.30 | = 0 | +0.80                |
| 58     | 1.00          | +1.97          | +0.73          | +1.18 | = 0 | +1.68                |
| 59     | 1.00          | +1.97          | +0.81          | +1.54 | = 0 | +2.11                |
| 60     | 1.00          | +1.97          | +0.81          | +0.68 | = 0 | +1.25                |
|        |               |                |                |       |     | $\Sigma v^2 = 37.00$ |

Normal Equations.

$$\begin{aligned}
 +24.0000x + 11.2100y - 8.0500\pi - 9.0400 &= 0 \\
 +36.7277 + 13.1132 - 1.9982 &= 0 \\
 +43.0283 - 23.6197 &= 0
 \end{aligned}$$

Solution.

| In units 2d dec. place.    | In Arc.                        |
|----------------------------|--------------------------------|
| $\pi = +0.8899 \pm 0.1600$ | $\pi = +0''.2493 \pm 0''.0448$ |
| $y = -0.5475 \pm 0.1811$   | $y = -0.1534 \pm 0.0507$       |
| $x = +0.9309 \pm 0.2184$   | $x = +0.2607 \pm 0.0612$       |

Scale. Arc.

$$\text{Prob. error of one equation} = 0.8952 = 0''.2507$$

TABLE V.—PARALLAX EQUATIONS.

COMPARISON STARS  $c$  AND  $d$ .

| Plate. |      |     |          |            |         |       | $v$                  |
|--------|------|-----|----------|------------|---------|-------|----------------------|
| 31     | 1.00 | $x$ | $-1.44y$ | $+1.82\pi$ | $+0.12$ | $= 0$ | $+0.52$              |
| 32     | 1.00 |     | $-1.44$  | $+1.82$    | $-0.02$ | $= 0$ | $+0.38$              |
| 33     | 1.00 |     | $-1.42$  | $+1.75$    | $-2.40$ | $= 0$ | $-2.06$              |
| 34     | 1.00 |     | $-1.42$  | $+1.75$    | $+0.23$ | $= 0$ | $+0.57$              |
| 38     | 1.00 |     | $-0.44$  | $+1.86$    | $-1.09$ | $= 0$ | $-0.20$              |
| 40     | 1.00 |     | $+0.01$  | $-1.81$    | $+3.48$ | $= 0$ | $+1.09$              |
| 42     | 1.00 |     | $+0.01$  | $-1.82$    | $+1.23$ | $= 0$ | $-1.17$              |
| 45     | 1.00 |     | $+0.55$  | $+1.84$    | $-1.60$ | $= 0$ | $-0.28$              |
| 46     | 1.00 |     | $+0.55$  | $+1.84$    | $-1.92$ | $= 0$ | $-0.60$              |
| 47     | 1.00 |     | $+1.02$  | $-1.82$    | $+3.53$ | $= 0$ | $+1.59$              |
| 48     | 1.00 |     | $+1.03$  | $-1.82$    | $+3.06$ | $= 0$ | $+1.13$              |
| 50     | 1.00 |     | $+1.03$  | $-1.82$    | $+2.56$ | $= 0$ | $+0.63$              |
| 51     | 1.00 |     | $+1.54$  | $+1.87$    | $-1.39$ | $= 0$ | $+0.40$              |
| 53     | 1.00 |     | $+1.56$  | $+1.84$    | $-0.46$ | $= 0$ | $+1.31$              |
| 58     | 1.00 |     | $+1.97$  | $-1.71$    | $+0.60$ | $= 0$ | $-0.80$              |
| 59     | 1.00 |     | $+1.97$  | $-1.74$    | $+1.05$ | $= 0$ | $-0.38$              |
| 60     | 1.00 |     | $+1.97$  | $-1.74$    | $-0.69$ | $= 0$ | $-2.12$              |
|        |      |     |          |            |         |       | $\Sigma v^2 = 19.38$ |

Normal Equations.

$$\begin{aligned}
 +17.0000x + 7.0500y + 2.1100\pi + 6.2900 &= 0 \\
 +28.5889 - 19.1220 + 9.9503 &= 0 \\
 +55.3681 - 42.4082 &= 0
 \end{aligned}$$

Solution.

| In units 2d dec. place.    |  | In Arc.                        |  |
|----------------------------|--|--------------------------------|--|
| $\pi = +0.9479 \pm 0.1262$ |  | $\pi = +0''.2655 \pm 0''.0353$ |  |
| $y = +0.4525 \pm 0.1849$   |  | $y = +0.1267 \pm 0.0518$       |  |
| $x = -0.6753 \pm 0.2108$   |  | $x = -0.1892 \pm 0.0618$       |  |

Scale. Arc.

Prob. error of one equation  $= 0.7935 = 0''.2222$

TABLE V.—PARALLAX EQUATIONS.

COMPARISON STARS *e* AND *f*.

| Plate. |               |                |                |       |     | <i>v</i> .           |
|--------|---------------|----------------|----------------|-------|-----|----------------------|
| 31     | 1.00 <i>x</i> | −1.44 <i>y</i> | −1.31 <i>π</i> | −0.11 | = 0 | −0.44                |
| 32     | 1.00          | −1.44          | −1.30          | +0.30 | = 0 | −0.02                |
| 33     | 1.00          | −1.42          | −1.19          | +1.49 | = 0 | +1.29                |
| 34     | 1.00          | −1.42          | −1.19          | −0.09 | = 0 | −0.29                |
| 41     | 1.00          | +0.01          | +1.49          | −1.51 | = 0 | +0.69                |
| 42     | 1.00          | +0.01          | +1.46          | −1.82 | = 0 | +0.35                |
| 43     | 1.00          | +0.55          | −1.36          | +1.03 | = 0 | −0.33                |
| 44     | 1.00          | +0.55          | −1.36          | +1.60 | = 0 | +0.24                |
| 46     | 1.00          | +0.55          | −1.34          | +1.07 | = 0 | −0.27                |
| 47     | 1.00          | +1.02          | +1.45          | −2.35 | = 0 | −0.69                |
| 48     | 1.00          | +1.03          | +1.42          | −2.78 | = 0 | −1.16                |
| 49     | 1.00          | +1.03          | +1.41          | −3.34 | = 0 | −1.73                |
| 50     | 1.00          | +1.03          | +1.40          | −1.58 | = 0 | +0.02                |
| 57     | 1.00          | +1.97          | +1.55          | −1.69 | = 0 | −0.37                |
| 58     | 1.00          | +1.97          | +1.55          | +0.33 | = 0 | +1.66                |
| 59     | 1.00          | +1.97          | +1.55          | −2.23 | = 0 | −0.91                |
| 60     | 1.00          | +1.97          | +1.55          | +0.62 | = 0 | +1.94                |
|        |               |                |                |       |     | $\Sigma v^2 = 15.07$ |

## Normal Equations.

$$\begin{aligned}
 +17.0000x + 7.9400y + 5.7800\pi - 11.0600 &= 0 \\
 +28.8344 + 22.9844 - 16.4388 &= 0 \\
 +33.7618 - 30.7096 &= 0
 \end{aligned}$$

## Solution.

| In units 2d dec. place.    | In Arc.                        |
|----------------------------|--------------------------------|
| $\pi = +1.1570 \pm 0.1783$ | $\pi = +0''.3241 \pm 0''.0499$ |
| $y = -0.4854 \pm 0.2006$   | $y = -0.1360 \pm 0.0562$       |
| $x = +0.4839 \pm 0.1820$   | $x = +0.1355 \pm 0.0510$       |

Scale. Arc.

$$\text{Prob. error of one equation} = 0.7001 = 0''.1961$$

TABLE V.—PARALLAX EQUATIONS.

COMPARISON STARS  $c$  AND  $\theta$ .

| Plate. |          |           |             |       |     | $r$ .                |
|--------|----------|-----------|-------------|-------|-----|----------------------|
| 31     | 1.00 $x$ | —1.44 $y$ | +1.89 $\pi$ | —1.63 | = 0 | +0.21                |
| 32     | 1.00     | —1.44     | +1.89       | —1.78 | = 0 | +0.06                |
| 33     | 1.00     | —1.42     | +1.84       | —2.52 | = 0 | —0.72                |
| 34     | 1.00     | —1.42     | +1.84       | —1.30 | = 0 | +0.50                |
| 38     | 1.00     | —0.44     | +1.93       | —1.47 | = 0 | —0.06                |
| 40     | 1.00     | +0.01     | —1.81       | +1.34 | = 0 | +0.55                |
| 41     | 1.00     | +0.01     | —1.81       | +0.35 | = 0 | —0.44                |
| 42     | 1.00     | +0.01     | —1.84       | +0.05 | = 0 | —0.75                |
| 43     | 1.00     | +0.55     | +1.91       | —0.61 | = 0 | +0.37                |
| 44     | 1.00     | +0.55     | +1.91       | —3.42 | = 0 | —2.44                |
| 45     | 1.00     | +0.55     | +1.90       | —1.23 | = 0 | —0.26                |
| 46     | 1.00     | +0.55     | +1.90       | +0.21 | = 0 | +1.18                |
| 47     | 1.00     | +1.02     | —1.84       | +1.77 | = 0 | +0.53                |
| 48     | 1.00     | +1.03     | —1.84       | +3.15 | = 0 | +1.90                |
| 49     | 1.00     | +1.03     | —1.84       | +0.63 | = 0 | —0.62                |
| 50     | 1.00     | +1.03     | —1.85       | +1.87 | = 0 | +0.62                |
| 51     | 1.00     | +1.54     | +1.91       | +0.33 | = 0 | +0.88                |
| 53     | 1.00     | +1.56     | +1.89       | —0.19 | = 0 | +0.34                |
| 57     | 1.00     | +1.97     | —1.66       | +1.77 | = 0 | +0.21                |
| 58     | 1.00     | +1.97     | —1.66       | +0.81 | = 0 | —0.75                |
| 59     | 1.00     | +1.97     | —1.70       | +1.84 | = 0 | +0.26                |
| 60     | 1.00     | +1.97     | —1.70       | —0.01 | = 0 | —1.59                |
|        |          |           |             |       |     | $\Sigma r^2 = 18.18$ |

Normal Equations.

$$\begin{aligned}
 +22.0000x + 11.1600y + 1.2600\pi - 0.0400 &= 0 \\
 +34.1358 - 22.3029 + 24.7459 &= 0 \\
 +74.1850 - 49.8911 &= 0
 \end{aligned}$$

Solution.

| In units 2d dec. place.    | In Arc.                        |
|----------------------------|--------------------------------|
| $\pi = +0.5381 \pm 0.0909$ | $\pi = +0''.1507 \pm 0''.0255$ |
| $y = -0.4362 \pm 0.1466$   | $y = -0.1222 \pm 0.0411$       |
| $x = +0.1923 \pm 0.1638$   | $x = +0.0539 \pm 0.0459$       |

Scale. Arc.

Prob. error of one equation = 0.6779 = 0''.1899

## II.—*The Myriapoda Collected by the United States Eclipse Expedition to West Africa, 1889 and 1890.*

BY O. F. COOK AND G. N. COLLINS.

Read March 13, 1893.

The west coast of Africa is very rich in species of Myriapoda, notably Polydesmidae and Julidae. Spirostreptus is to be considered the characteristic genus, of which more than a hundred species have already been described from different parts of Africa. The Cape of Good Hope has furnished a majority of these; the only other locality which has received anything like a thorough investigation is Benguela, the species of which are described by Porath in "*Myriapoda Africae Australis*." The considerable number of species from other localities is the result of casual collection by persons not specially interested in the group, and so the subject is in a fragmentary condition. It is a matter of some regret to us to make an addition to this scattered literature, but there seems to be no other course. The species here noticed were collected at points remote from each other, ranging all the way from Senegambia to Cape Town. We have attempted to make our descriptions and figures sufficiently complete and definite to insure the recognition of the species if found again.

When Dr. Riley sent us the material for study it was the intention of the government authorities to publish at one time the complete scientific results of the expedition; but as this seemed likely to be indefinitely deferred, it was thought best to offer this paper elsewhere. The materials on which it is based are in the collection of the National Museum at Washington.

SYRACUSE UNIVERSITY, March 1, 1891.

1. **Paradesmus thysanopus**, sp. n.

Plate I, figs. 1-6.

Body rather slender, slightly flattened, narrowed slightly and gradually anteriorly, more abruptly posteriorly.

Vertex smooth, sulcus beginning as a fine line at the posterior margin, and gradually widening and deepening to just below the antennæ, where it ends; near the lateral edge of the antennal opening a small, well-defined, circular surface, apparently not chitinized.

Clypeus short, smooth above, wrinkled and hirsute below, the lower bristles longer, and arranged in more or less regular transverse rows; a shallow transverse furrow above the labrum.

Labrum very short, the emargination moderate or shallow, with three small, more or less blunt teeth, sometimes separated from each other.

Antennæ 6 or 7 mm. long; second joint longest, but the third subequal to it; the other three distally decreasing, though but very slightly; seventh subequal to the first; distal joints densely pilose, the others slightly.

Mandibular stipe with the exposed surface (buccal area) large, triangular, anteriorly truncate, sparsely hirsute, marked with three furrows arranged in the form of a right triangle, with the right angle toward the clypeus.

Masticatory plate crescent-shaped, crossed by seven transverse, spine-bearing ridges.

Masticatory cushion and a fringed lamella along the masticatory plate well developed, the projections black.

Mandibular tooth triangular, rounded at apex.

Dentate lamella with four blunt teeth.

Pectinate lamellæ six, as is usual in this family, but all the lamellæ may not be complete, that is, there may be five lamellæ, one being branched.

Mentum triangular, of equal length and breadth, the posterior edge deeply and broadly emarginate, the apex very acute; a few short bristles along the median line.

Stipe of gnathochilarium with broad, produced anterior corners; with long bristles on the anterior margin, and with short ones over its whole surface, excepting along the lateral margins.

Lingual laminæ hirsute over the entire surface, the anterior bristles longer.

First segment smooth, anterior edge curved, the posterior nearly straight, so that the general outline is that of half of an ellipse divided by the long axis.

Second segment very convex and smooth above, of about equal length,<sup>1</sup> but broader than the first; upper carina slightly produced at the anterior angle, more at the posterior, with a raised margin above.

Third and fourth segments each about as long as the second, but the carinæ smaller, the anterior angle wanting, the posterior better developed than upon the second segment.

---

<sup>1</sup> The terms long and short refer to dimensions taken in the general direction of the long axis of the body; broad and narrow to those more or less perpendicular to the long axis.

Fourth and subsequent segments longer, above with a slight transverse furrow across the middle of the posterior subsegment; furrow disappearing on the seventeenth segment; posterior segments with a faint median longitudinal sulcus; superior carinæ posteriorly pointed, decreasing on the last three segments, those of the nineteenth nearly obsolete. All the segments, except the first and the last four have a rather slight oblique inferior carina located so as to make the outline of a cross-section of the posterior subsegment somewhat quadrangular; segments longitudinally wrinkled between the carinæ.

Repugnatorial pores large, circular, located on the lateral face of the carina, and near the posterior margin of the segment.

Last segment finely roughened, a few bristles on its posterior margin, and one on each side of the base of the smooth, slightly decurved, scarcely attenuated mucro, which is elliptical in cross-section, and bears on its truncate apex four short bristles. Sides of end a little swollen, and the under side of mucro with a shallow groove, so that when held at the proper angle it appears slightly emarginate.

Anal valves wrinkled above and along the compressed margins; on each valve near the margin, and at about equal distances from the top and bottom of the valves and from each other, two long bristles.

Pre-anal scale triangular, obtuse, about as wide as long, with a bristle on each side below the apex.

First pair of legs 2 mm. long, much shorter than the others; third joint longest, slightly exceeding the second, which is but little longer than the subequal first, fourth, fifth, and sixth; fifth joint in males with a dense hairy fringe along the distal half of its inferior edge; the sixth joint with such a fringe along nearly the whole of the inferior edge; surface of all the joints sparsely hirsute. The fringes appear on all the legs to the tenth or twelfth pair, where that of the fifth joint is lost; that of the sixth becomes gradually shorter and disappears before the fourteenth or fifteenth segments.

Second pair of legs longer than first, 2.8 mm., the comparative length of joints the same.

Fourth pair of legs of male, and the third or fifth (the specimen was damaged) with the third joint swollen on the lower side, and provided with a truncate conical obliquely directed protuberance open at the end. The opening leads to a flask-shaped cavity containing an irregular homogeneous mass; in two cases it appeared that there was a tubular passage leading from the cavity upward inside the joint, but in another leg the wall of the cavity appeared very distinctly defined, and no trace of interior connection could be made out.

Subsequent legs gradually longer, to about 6 mm., moderately hirsute.

Genitalia of male—see plate I, figs. 1, 2.

Color of alcoholic specimens from chocolate-brown to nearly black, the labrum, margins of first segment, posterior margin, both carinæ, and ventral surface of other segments, mucro, and proximal joints of legs, pale yellow; antennæ brown. The yellow posterior margin of the segments is sometimes obsolete, and the ventral surface and distal portions of the joints of the legs may be pale reddish-brown.

Length of longest specimen 26 mm.; diameter of segments 3 mm.

*Habitat*.—One male and a portion of another, and two females, from "Congo, Jan. 2."

This species is distinct from *P. gracilis* C. Koch, in its larger size, smaller carinæ, faint transverse sulcus of posterior subsegments, the fringes of the two penultimate joints of the legs, the structure of the fourth pair of legs, male genitalia, and in having no row of granules between the subsegments; from *P. Liberiensis* Peters, in having all the carinæ posteriorly pointed, the posterior margin of the first segment straight, the yellow markings, and the smaller size; from *P. ornatus* Peters, in the straight posterior margin of the first segment, anterior segments not noticeably directed forward, pores on the lateral surfaces of the carinæ, and much smaller size.

## 2. *Alloporus bipunctatus*, sp. n.

Plate II, figs. 15, 16.

Body cylindrical, slightly constricted anteriorly, the fourth segment narrowest; last six or seven segments rapidly decreasing.

Covered portion of epicranium with fine, branching, longitudinal striations, the striated area twice as wide on the ends as in the middle, where it is bisected by a prolongation of the vertex sulcus.

Vertex smooth or with very fine irregular longitudinal striæ, the median sulcus obsolete, but the suture distinct, meeting the rather obscure intra-ocular suture in a deep foveola.

Clypeus smooth above, wrinkled below, near the middle a broad depression; upper row of two bristle-bearing punctations, one over each end of the labral emargination; lower row of seven or eight smaller punctations on each side of, and five behind the excavation.

Labrum with a moderate excavation and three well-defined, though blunt teeth.

Eyes pointed-oval, distant from each other by scarcely the transverse diameter of an eye; ocelli of right eye arranged:  $11 + 10 + 9 + 8 + 7 + 4 = 49$ , of left,  $11 + 10 + 9 + 8 + 7 + 4 + 2 = 51$ .

Antennæ 6.5 mm. long, second joint longest, the third, fourth, fifth, and the sixth and seventh taken together, about equal in length.

Mandibular stipe with the exposed surface subrectangular in outline, convex, with raised margin; anterior inferior corner somewhat produced.

Masticatory plate triangular, twice as long as broad, the surface rough with short spines; margin raised; at the broad end a deep groove.

Mandibular tooth oblong, more than twice as long as broad, the end rounded.

Dentate lamella with five rounded teeth.

Pectinate lamellæ of eleven complete rows of spines, and one short row.

Mentum about ~~six~~ times as wide as long; anterior margin broadly sinuate; anterior corners rounded; lateral margins posteriorly converging.



Promentum without bristles, widest in the middle; a distinct line of demarcation between the narrow, posterior, plane surface and the anterior concave one.

Stipe with broad base, a few bristles on the anterior margin and anterior portion of lateral margin, one large spine near the anterior interior angle.

Lingual laminae with three short bristles near the posterior, and three long ones near the anterior end.

First segment finely rugulose and punctate; corners scarcely produced, nearly rectangular; one complete, and two fine marginal striations.

Subsequent segments with the anterior portions concentrically striate, on the striations small pits at considerable distance from each other; posterior part of segment highly convex, so that the body appears slightly moniliate, punctate, and finely rugulose; sides smooth above, moderately striate below, the striations more extensive on the anterior segments but not appearing above the pores.

Repugnatorial pores longitudinally elliptical, situated below the middle, slightly nearer to the suture than to the posterior margin, suture strongly sinuate in front of pore.

Penultimate segment very short.

Last segment long, posterior margin depressed, rounded, more rugulose than the anterior portion, not covering the anal valves.

Anal valves finely punctate, not much exceeding the last segment, not much inflated, the margins rather thick, compressed, next to them a shallow, irregular furrow.

Pre-anal scale about three times as broad as long, rounded.

Color of alcoholic specimen a uniform dark reddish-brown, the anterior and inferior portions of the segments paler; feet dark reddish.

Length 95 mm.; greatest diameter 7 mm.; 57 segments.

*Habitat*.—One female specimen (Ac. 23,272) is labeled "Free Town, Sierra Leone."

### 3. *Spirostreptus variabilis*, sp. n.

Plate II, figs. 11-14.

Body cylindrical, gradually narrowed anteriorly to the eighth or ninth segment, then increasing to the second and first; last seven or eight segments rather abruptly decreasing.

Covered portion of epicranium finely striate longitudinally, anteriorly bordered by a transverse sulcus, which may be straight or considerably curved at the sides.

Vertex smooth or rugulose, sometimes, in females, with one or more transverse striations above; median sulcus nearly obsolete, but the suture distinct, ending in a transversely elliptical, deep foveola between the eyes, which are connected by a transverse suture crossing the foveola.

Clypeus in male faintly rugulose, appearing smooth, medianly and below the line of the antennae is a large flat or depressed space; in the female the

clypeus is coarsely rugose over its entire surface, on each side just mesad of the antennæ a deep, irregular excavation, and on each side about half-way between the antennæ and the labrum a crescent-shaped excavation, with the concave side towards the antenna. Upper row of four punctations, sometimes nearly obsolete or reduced to three; lower row of punctations consisting of from three to nine on each side of the emargination, and from none to eight behind it.

Labrum with a shallow or deep emargination; teeth usually three, occasionally two or one, or nearly obsolete, either broad and truncately blunt, or narrower and rather sharp-pointed.

Eyes triangular in shape, the upper and exterior edges convex outwardly, the lower concave; the usual arrangement of the ocelli is  $12 + 11 + 10 + 9 + 7 + 5 + 2 = 56$ , which order is varied to  $11 + 10 + 9 + 8 + 6 + 3 + 2 = 49$  or  $12 + 11 + 10 + 9 + 8 + 6 + 2 = 58$ , or  $13 + 12 + 11 + 10 + 9 + 7 + 5 + 2 = 69$ ; eyes distant from each other by about two-thirds of the transverse diameter of an eye.

Antennæ with the second joint longest, the others gradually decreasing in length; first and second joints smooth or with sparse hairs, the other joints increasingly hirsute to the end; length 8–9 mm.; if held parallel to each other they scarcely attain the third segment; no disparity in length between the sexes.

Mandibular stipe with the exposed surface nearly plane, subquadrate, provided with a raised margin; anterior inferior angle sometimes produced.

Masticatory plate about twice as long as broad, triangular, surrounded by a raised edge; near and parallel to its broad end a transverse ridge separates it into two unequal parts, the smaller of which is a deep groove not beset with the short spines common on the remainder of the surface.

Mandibular tooth oblong, about three times as long as broad, the end rounded, obtuse.

Dentate lamellæ with four or five blunt teeth; the incisions between are sometimes so slight as to make the margin of the lamella scarcely uneven.

Pectinate lamellæ of eleven more or less complete rows of broad, blunt, curved spines.

Hypostoma arcuate, the inferior surface without longitudinal striæ, anterior margin in male broadly emarginate, in female straight or slightly concave medianly.

Mentum trapezoidal, in the female six times broader than long, in the male nine times, the part posterior to the stipe being apparently modified into a large secondary cardo.

Promentum without bristles, the anterior margin sometimes nearly straight with a rather abrupt median protuberance, or convex, with a smaller protuberance. In the male the ventral surface of the promentum has the anterior two-thirds of its area concave; in the female this depression is more pronounced, and is separated from the level posterior area by a well-defined edge.

Stipe with three or four large bristles on the anterior margin, and a row along the anterior half or two-thirds of the lateral edge, and a small bristly

area near the anterior portion of the lateral margin, also one stout bristle near the anterior-interior corner.

Lingual laminae beset with bristles on the posterior third, and three large ones near the anterior end.

First segment finely punctate, the anterior angles slightly produced in male, not produced in female, rounded, with five curved, and occasionally irregular or branched sulcations, the upper one beginning opposite the eye.

Segments subsequent to the first with about ten occasionally branched striations on the anterior portion, and just in front of each striation a row of sharp conical protuberances which are usually distant from each other by a space greater than that between the striations; posterior portion of segments with very numerous punctations and irregular longitudinal ridges, the posterior edge depressed; the longitudinal striations of the sides begin on the anterior segments above the pores, on the posterior segments below them.

Repugnatorial pores oval, located at about the middle of the side, not remote from the suture, which is sinuate in front of them.

Last segment rugulose above posteriorly, and with the posterior portion depressed; mucro not equalling the anal valves, obtuse, rounded.

Anal valves finely punctate, wrinkled in the depressed portions, rather prominently compressed-margined.

Pre-anal scale broad, rounded-triangular, considerably exceeded by the anal valves.

First pair of legs of male with the large sternum hirsute with short bristles on its lateral expansions; coxæ with a large, triangular, dorsally directed process on the upper side.

Third and subsequent legs of male with a large, pointed, transparent, chitinous process rising from the ventral edge of the distal third of the two penultimate joints, much smaller on posterior legs.

Genitalia of male—see plate II, figs. 13, 14.

Color of alcoholic specimens dark brown, the labrum in some cases black, anterior portion of segments pale bluff; feet and antennæ dull reddish-brown.

Length 95–110 mm.; greatest diameter 8–10 mm.; 52–56 segments.

*Habitat.*—Four males and four females are labeled, “St. Paul de Loanda, Dec. 13, 1889” (No. 292); one female “Loanda” (Ac. 23,400); one female “Congo, Dec. 25.”

This species is instructive as giving light on the subject of variation in the genus. We have combined in our description characters supposed by some writers to be of great importance, such as the presence or absence of labral teeth, being compelled to this course by the fact that while the extremes of variation are very distinct, the intervening stages are present, and that great deviation from the usual form may exist in respect to some one character without being accompanied by any other noticeable differences.

**4. *Spirostreptus tripartitus*, sp. n.**

Plates II and III, figs. 17-22.

Body cylindrical, widest about one-fourth of the length from the posterior end, gradually narrowed anteriorly to about the eleventh segment, in front slightly larger.

Covered portion of epicranium with moderately pronounced longitudinal striations.

Vertex with a broad and deep sulcus, rugulose to the transverse intra-ocular suture; the two sutures meeting in a slight depression.

Clypeus faintly and distantly rugulose; near the lateral margins on each side a flattened, or even excavate area; upper row of four irregular, large, shallow punctations; lower row of seven or eight punctations on each side of, but none above, the emargination. None of the punctations are furnished with hairs, but each has a small rounded protuberance at the bottom.

Labrum with a deep emargination; labral teeth very small and blunt and distant from each other, above them a rather deep groove.

Eyes shaped like half the loop of a lemniscate, arranged  $11 + 10 + 9 + 7$  or  $8 + 6 + 5 + 2 = 50$  or  $51$ ; distant from each other by about the transverse diameter of an eye.

Antennæ with the second joint longest, the others gradually decreasing in length, the seventh very short; length 10 mm., diameter of joints about 1 mm.

Mandibular stipe with the exposed surface nearly plane, oblong, with a raised margin along the lower edge.

Masticatory plate triangular, about twice as long as broad, with a raised edge; upper portion a deep groove, the exterior edge of which does not attain to the plane of the larger triangular portion, and is without spines.

Mandibular tooth triangular, obtuse at point, about twice as long as broad.

Dentate lamella with five blunt teeth.

Pectinate lamellæ of eleven complete rows of blunt spines.

Hypostoma with longitudinal striations on the inferior surface of the broad ends; anterior margin medianly produced, otherwise nearly straight.

Mentum tripartite, the median piece oval, about half as long as the lateral pieces, and nearly equal to them in width; lateral pieces trapezoidal, the posterior interior corner produced.

Promentum with posterior corners produced; anterior margin but little convex outwardly; anterior third beset with numerous bristles.

Stipe with four or five large bristles on the anterior edge, and a fringe of them along the anterior two-thirds of the lateral edges; portion bordering on the promentum also beset with bristles; a stout, blunt, dark-brown spine is located near the anterior-interior corner.

Lingual laminae beset with bristles on the posterior half, and three large ones toward the anterior end.

First segment nearly smooth, slightly rugulose on the sides; anterior lateral angle considerably produced, rounded, the lateral edge straight, directed slightly upward posteriorly, posterior corner very obtuse; four complete striations, sometimes branched, or with one or two short striæ.

Subsequent segments with about seventeen concentric striations on the anterior portion, on the striations small protuberances distant from each other by a space equal to that between the striations; posterior portion with very fine longitudinal wrinkles and furrows; the striations which are strongly developed below, extend considerably above the pores on the anterior segments.

Repugnatorial pores below the middle line, longitudinally elliptical, situated near the suture which is sinuate in front of them, especially on the anterior segments.

Last segment with the posterior portion slightly depressed and more rugulose, with rounded mucro, the margins slightly uneven below.

Anal valves nearly smooth, not very prominently inflated, the margins not strongly compressed, of moderate thickness.

Pre-anal scale two and one-half times as long as wide, posteriorly very obtuse, rounded.

First pair of legs with their large sternum hirsute on the median portion of the expanded surfaces, and a fringe of bristles along its margin; coxa large, flat, punctate, and hispid with short bristles, provided with a conic curved dorsally directed process.

Third and subsequent pairs of legs with a large, pointed, transparent, chitinous process arising from the distal half of the penultimate joints, becoming smaller posteriorly.

Genitalia of male—see plate II, figs. 18, 19.

Color of alcoholic specimens: head, first segment, and posterior part of subsequent segments brownish-black; anterior portion of segments dull reddish-brown; colors lighter below, feet and antennæ dark reddish.

Length 170 mm.; greatest diameter 10 mm.; 72 segments.

*Habitat.*—Two male specimens with the label "Congo, Dec. 25."

##### 5. ***Spirostreptus anodontus***, sp. n.

Plate III, fig. 23.

Body cylindrical, gradually narrowed anteriorly to the fourth segment, then increasing to the first; narrowed gradually posteriorly from the 60th to the 66th, and thence rapidly decreasing.

Covered portion of epicranium with strongly pronounced longitudinal striations running into the transverse furrow in front.

Vertex finely rugulose, with coarse striæ running diagonally into the strongly pronounced median sulcus which meets the transverse intra-ocular suture in a longitudinally oval depression.

Clypeus finely rugulose; below and mesad of the antennæ a deep, irregular, rugose depression; median portion of lower part of clypeus strongly convex, but the lateral margins rather abruptly flattened; upper row of four nearly obsolete punctations reduced to shallow depressions; lower row also reduced to shallow, longitudinally oval depressions, either without any protuberance at bottom, or with it very small and blunt; about nine punctations on each side of the emargination, and six or seven very rudimentary ones behind it.

Labrum with a deep and rather narrow sinus and no trace of the teeth which are so nearly universal in Chilognaths.

Eyes of the usual semi-lemniscate shape, distant from each other by a space equal to the transverse diameter of an eye; ocelli of the right eye of the specimen examined  $10 + 11 + 10 + 9 + 9 + 5 + 5 + 1 = 60$ , of the left  $10 + 11 + 9 + 8 + 8 + 6 + 3 = 55$ . The ocelli of the upper parts of the eyes are, as is usual in *Spirostrepti*, many times larger than some of the lower ones. In the left eye the arrangement into transverse rows is so broken as to make the above formula rather arbitrary.

Antennæ with the second joint longest, but not as long as the fifth and sixth taken together, the other joints decreasing in length from the second; length 12 mm., transverse diameter of joint 1.2 mm.

Mandibular stipe with its outer surface oblong, subrectangular, surrounded by a raised margin.

Masticatory plate twice as long as broad, triangular, surrounded by a raised margin; broad end a deep groove separated from the remainder of the surface.

Mandibular tooth oval, with the sides rather straight and the end truncate; more than twice as long as broad.

Dentate lamella of five teeth, which are either entirely connate or with a shallow incision separating them, so that the cutting edge of the lamella is nearly straight.

Pectinate lamellæ of eleven complete rows of blunt, curved spines.

Hypostoma arcuate, the ends longitudinally striate on the inferior surface, anterior edge straight.

—Mentum nearly rectangular, about six times as long as broad, the surface rough.

Promentum with posterior margin straight, the anterior but little convex; anterior two-thirds concave, with a curved line of demarcation; anterior third beset with bristles.

Stipe with a fringe of bristles along the margin to near the base, and along the interior margin opposite the promentum; a very short blunt bristle near the anterior-interior corner.

Lingual laminæ beset with bristles on the posterior portion, and with a few long ones anteriorly.

First segment anteriorly finely wrinkled, posteriorly more coarsely, with occasional shallow depressions, one of which on each side close to the median line is much more pronounced; lateral inferior margin nearly straight, corners rounded, not produced; three of the usual striations run diagonally across the segment, while one or two are interrupted. Starting from the middle of the superior striation is a longitudinally directed furrow, and just above this a very pronounced convexity of the surface of the segment, bearing on the middle portion several shorter longitudinal furrows; the whole posterior portion of the segment is swollen, appearing noticeably convex when viewed from the side; posterior edge strongly emarginate, though the segment is twice as long in the middle as near the lateral edge.

Subsequent segments have about twelve irregular and broken concentric

striations on the anterior portion, just anterior to each of which is a row of very small protuberances about as far from each other as the striations are apart; posterior portion of segments finely punctate, dorsally with poorly defined longitudinally directed furrows, depressions, and ridges; laterally these become more pronounced and gradually take on the character of the striations which are strongly developed on the sides and below; well-developed striations appear above the pores on the anterior segments, but not on the posterior.

Repugnatorial pores located below the middle line of side, longitudinally oval on the anterior segments, where the suture is curved away from them; they are farther from the posterior margin than from the suture, which in the posterior part of the animal is nearly or quite straight.

Last segment posteriorly strongly contracted, rugose above on the small and rather pointed, though broad, mucro which does not nearly cover the edges of the anal valves.

Anal valves rugulose, more coarsely wrinkled above and along the slightly compressed, rather thick margins.

Pre-anal scale with the exposed portion somewhat over three times broader than long, the posterior margin rounded.

Color of alcoholic specimen: median parts of head, posterior part of each segment, anal valves, and pre-anal scale very dark brown, nearly black; sides of head, antennæ, and legs of a more or less dark reddish-brown; the anterior portion of each segment shading into dirty yellow, all the colors paler below; sides of the posterior margin of the last segment yellow.

Length 210 mm.; greatest diameter 14 mm.; 70 segments.

*Habitat.*—One female specimen is labeled "Cape Town, Feb. 2, 1890."

With the specimens which we have called *tripartitus* was a female of about the same size as the above species, and differing in the following characters:—

Body more compressed laterally toward the posterior end, and attenuate for a longer distance anteriorly; transverse furrow of vertex curved, medianly obscure; the rugose area in front of the antennæ more evident, and slightly depressed; upper row of punctations better developed, with blunt protuberances at bottom; lower row less in number, and less pronounced; anterior ventral corner of exposed surface of mandibular stipe more produced; eyes 62; anterior edge of promentum without a distinct median convexity, though the general outline of the rather irregular margin is anteriorly convex.

These differences do not seem to us of sufficient importance to justify the establishment of another species, and yet it does not appear advisable to combine the descriptions of the two specimens.

This species, supposing the two specimens to belong to it, has its most important difference from *S. tripartitus* in the characters of

the mentum and hypostoma. It is not impossible that these differences are sexual, but on this point no information is available.

We are aware that these three species of *Spirostreptus* do not differ by any very important characters from many previously published descriptions, though they do not appear to be entirely in accord with any. A large part of the older descriptions consist chiefly of accounts of the colors of alcoholic or dried specimens, in which the colors depend on the strength of the alcohol, the rapidity of the drying process, or the age of the specimens, as we have frequently observed in collecting species of this family. There are numerous descriptions which do not give a single morphological character not present, in all probability, in every *Spirostreptus*, and it appears to us that to describe these specimens as new will be likely to cause less confusion than to make a random reference of them to species practically undescribed, our species being characterized, we hope, with sufficient completeness to make their identification possible to any one studying the older types. In the other case such study would be quite as likely to prove the distinctness of the forms before us, and to cause complications in the literature of the subject much greater than the simple reduction of our specific names to synonyms.

We are also aware that many of the characters mentioned by us could probably be relegated to a properly prepared generic description, had such been drawn up.

The distinctions between *Spirostreptus* and allied genera are by no means settled. Latzel puts forward the number of pectinate lamellæ as an important generic character, and states that *Alloporus* has eight, and *Spirostreptus* nine or ten. We have found eleven to be the constant number in the specimens referred to these genera, but sometimes the rows are more or less incomplete, so that variation in the number appears probable, and hence the only remaining distinction between the two genera is the possession by *Alloporus* of repugnatorial pores on the fifth segment, and the importance of this character is more or less weakened by the fact that on specimens of *Spirostreptus*, rudimentary pores, in the shape of small depressions, sometimes occur on the fifth, fourth, and third segments.



6. **Odontopyge furcata** (Karsch).

Plate III, figs. 24-28.

*Spirostreptus (Odontopyge) furcatus*, Karsch: Neue Juliden des Berliner Museums, 22.

Body cylindrical, narrowed posteriorly and very slightly anteriorly, not constricted.

Covered portion of epicranium with two well-pronounced transverse striations, the space between which is finely striated longitudinally.

Vertex smooth or very finely striate longitudinally; sulcus obsolete, but the suture distinct, as well as the transverse intra-ocular suture which it joins.

Clypeus smooth, with a large shallow depression slightly below the middle; upper row of six or eight punctations; lower row of five to seven on each side of, and six behind the emargination; each of the punctations has a bristle, some of which are .125 mm. long.

Labrum with a shallow emargination and three rather blunt teeth which project far enough to have their ends nearly in line with the edge of the labrum, in which is a notch on each side near the emargination.

Eyes pointed-oval, distant from each other by about the transverse diameter of one of them; not close to the antennæ; ocelli subequal, arranged  $11 + 10 + 9 + 8 + 7 + 5 + 3 = 53$ .

Antennæ 4 mm. long, second joint longest, the others gradually shorter; fifth and sixth taken together longer than the second.

Mandibular stipe with the exposed face convex, with a plane or slightly raised margin, in outline subrectangular the anterior edge faintly emarginate.

Masticatory plate rounded-triangular, about twice as long as broad, divided into a flat triangular, roughened surface with a raised margin, and a broad groove much below the plane of the roughened surface.

Mandibular tooth triangular, with rounded apex, about twice as long as breadth of base.

Dentate lamella with five teeth, four of them rather long, with rounded apices, the fifth very broad.

Pectinate lamellæ nine.

Hypostoma moderately arcuate, the ends enlarged and with a chitinated projection on their posterior edge.

Mentum about six times as broad as its median length, the ends very narrow. Between the narrow ends of the mentum and the hypostoma is on each side a membranous pouch into which fits the large process of the coxa of the first pair of legs.

Promentum without bristles, shaped like half of an ellipse divided by its short axis; a narrow posterior portion plane, the larger anterior part concave, with a distinct line of demarcation.

Stipe with bristles along the promentum and the anterior half of the exterior margins.

Lingual laminæ with a few short bristles at base and three long ones toward the anterior margin.

First segment smooth, anterior lateral angle rounded; one complete and deep striation, and a branched, more shallow, marginal striation.

Subsequent segments: anterior subsegment with seven or eight concentric striations on its anterior portion, the striations with small protuberances about as far apart as the striations are from each other; some of the protuberances not on the striations, but located without regularity on that part of the subsegment which is behind the striations. Posterior subsegment rugulose with fine curved and branching wrinkles whose general direction is longitudinal; the coarser striations of the sides and inferior surface begin about two-thirds of the distance from the dorsal median line to the repugnatorial pore. Supplementary margin finely and equally pectinate, points of teeth free, prominent.

Repugnatorial pores small, longitudinally suboval, situated on the middle line of side, and midway between the straight suture and the articulation.

Last segment rugose above, smoother below and finely punctate, carinate on the median line above; posterior angle somewhat produced, rounded.

Anal valves rugulose-punctate, each with a prominent carina which encloses a crescentic space between it and the well-pronounced, but moderately compressed margin; the carina is produced above into a large sharp-pointed, slightly recurved mucro.

Pre-anal scale punctate, rounded, nearly twice as wide as long.

First pair of legs with the expanded portion of sternum provided with a few short spines; coxa of male with a large, flattened, wrinkled, anteriorly and laterally directed, curved process.

Third and subsequent pairs without chitinous processes on the penultimate joints.

Genitalia of male—see plate III, figs. 27, 28.

Color of alcoholic specimens chestnut-brown, alternating with yellow; anterior portion of each posterior subsegment brown, the posterior margin, and usually a broad dorsal median line, yellow or buff; feet pale reddish, antennæ chestnut-brown; anterior and ventral portions of segments buff. In the young the colors are paler and less distinct, so that the general color appears to be a dirty yellow.

Length 60 mm.; diameter 4 mm.; 64 segments.

*Habitat.*—Two male, one female, and one young specimen from "Loanda."

## 7. *Scolopendra morsitans*, Linn.

To this polymorphous species we have referred nine specimens, all the Chilopoda of the collection. Six specimens, males and females from Loanda (Accession 23406), and a female and a young specimen from "Congo" present no noteworthy deviation from the usual form of this species, except that the superior surfaces of the basal joints of the anal legs, though somewhat flattened, are not at all margined. In discussing this species Meinert remarks:

"Perhaps this *Scolopendra* is the most inconstant species among all Myriapods, but also very few animals are so common and widely distributed as *Sc. morsitans*; yet through all its variations the short, flat, marginated pedes anales with three rows of larger spines on the underside of the femora are seldom missed." Kohlrausch, however, has called attention to the fact that in African specimens the margins are "not very sharp," and as all the other characters of the examples before us, including the number and arrangement of the spines, are those most usual in this species, we can only refer them here. One female from St. Helena differs from the others only in having well-developed margins on the three basal joints of the anal legs. The specimens vary in length from 37 to 87 mm., and in color from pale olive-brown with green margins to the segments and ochraceous head and anal legs, to entirely brown with no olive tinge. One of the two young specimens is pale olive-green throughout, the other brown. All the brown specimens appear to have been dried before being put into alcohol.

## EXPLANATION OF THE PLATES.

### PLATE I.

#### PARADESMUS THYSANOPUS, sp. n.

- Fig. 1. Genitalium. The dotted line indicates the course of the duct.
- Fig. 2. Different view of another genitalium.
- Fig. 3. Leg—one of the first pair.
- Fig. 4. Leg—one of the fourth pair.
- Fig. 5. Leg—one of the ninth pair.
- Fig. 6. Gnathochilarium.

#### SPIROSTREPTUS VARIABILIS, sp. n.

- Fig. 7. Series of dentate lamellæ.
- Fig. 8. Series of labra.
- Fig. 9. Gnathochilarium of male.
- Fig. 10. Gnathochilarium of female.

### PLATE II.

#### SPIROSTREPTUS VARIABILIS (*continued*).

- Fig. 11. First pair of legs.
- Fig. 12. Third pair of legs.
- Fig. 13. Genitalia, anterior view. Duct indicated as in fig. 1.
- Fig. 14. Genitalia, posterior view.

#### ALLOPORUS BIPUNCTATUS, sp. n.

- Fig. 15. Gnathochilarium of female.
- Fig. 16. Dentate lamella.

#### SPIROSTREPTUS TRIPARTITUS, sp. n.

- Fig. 17. Gnathochilarium of male.
- Fig. 18. Genitalia, posterior view. Duct indicated as in fig. 1.
- Fig. 19. Genitalia, anterior view.

## PLATE III.

SPIROSTREPTUS TRIPARTITUS (*continued*).

- Fig. 20. First pair of legs.  
Fig. 21. Second pair of legs.  
Fig. 22. Third pair of legs.

## SPIROSTREPTUS ANODONTUS, sp. n.

- Fig. 23. Gnathochilarium of female.

## ODONTOPYGE FURCATA (Karsch).

- Fig. 24. Gnathochilarium of male.  
Fig. 25. First pair of legs.  
Fig. 26. Second pair of legs.  
Fig. 27. Part of genitalium, anterior view.  
Fig. 28. Genitalia, posterior view. Duct indicated as in fig. 1.

### III.—*Studies on the Life-history of some Bombycine Moths, with Notes on the Setæ and Spines of Certain Species.*

BY ALPHEUS S. PACKARD.

Read March 13, 1893.

The attempt has been made in this and other articles, so far as material and opportunity have allowed, to describe the transformations of some of our Bombycine moths, in the light of the recent very suggestive and stimulating work of Weismann, entitled "*Studies in the Theories of Descent*" (1882). Until within a few years the majority of descriptions of caterpillars have been prepared simply for the purpose of identification, or for taxonomical uses, and without reference to the philosophic or general zoölogical significance of these changes. The transformations of some of the European Sphingidæ have been very carefully worked out by Weismann, and also by Poulton, but it is believed that the life-histories of the lower, more generalized Bombyces, especially of the Notodontidæ, Ceratocampidæ, Saturniidæ, Hemileucidæ, Cochliopodidæ, and Lasiocampidæ, will bring out still more striking and valuable results, inasmuch as they, or forms near them now extinct, are believed to be closely similar to the stem-forms from which all the higher Lepidoptera have probably been evolved.

The aim therefore in such studies should be—

1. To treat the larvæ as though they were adult, independent animals, and to work out their specific and generic as well as family characters.
2. To trace the origin of mimetic and protective characters, and to ascertain the time of larval life when they are assumed, involving—
3. The history of the development of the more specialized setæ (hairs), spines, tubercles, lines, spots, and other markings.<sup>1</sup>

<sup>1</sup> Besides the work of Weismann, compare also the suggestive papers of E. B. Poulton, in *Transactions of the Entomological Society of London*, 1884-88, and my papers: *Proceedings of the Boston Society of Natural History*, xxiv-v, 1890-91.

4. To obtain facts regarding the ontogeny of our native species and genera, which when added to what we know of the life-histories of European, Asiatic, and South American Bombyces, may lead to at least a partial comprehension of the phylogeny of the higher Lepidoptera, viz., those above the Noctuina and Geometrina, and the Microlepidoptera.

Thus far we have obtained facts sufficient, we believe, to enable us to make a more natural classification than heretofore of the families or groups of the Bombyces and allied forms, and these facts are in general, though not always, correlated with the characters of the imagines. The Notodontidæ appear to stand at the base of the Bombycine series, the Ceratocampidæ stand next above them, and from the latter have arisen the Saturniidæ and the Hemi-leucidæ, while the Cochliopodidæ may have originated from the Saturniidæ, or an allied but extinct group. On the other hand, the Lasiocampidæ may have been the stem-forms from which the Liparidæ, Arctiidæ, Lithosiidæ, and Zygænidæ, with their allies, have sprung.

In describing caterpillars, particularly those of the Bombyces, I have been particular to distinguish between the three thoracic and the abdominal segments, because the former usually differ in the number, arrangement, and relative size of the tubercles, warts, and other markings, from the abdominal segments. The warts or tubercles also are grouped into dorsal, subdorsal, and often a supra-spiracular (though this may in some cases be the subdorsal row) and an infra-spiracular row or series.

The author hopes finally to embody in a monograph of the Bombyces, which he has in preparation, not only the following but other descriptions. And he would be thankful to collectors and students for the eggs and larvæ needed to enable him to fill up the gaps in our present knowledge of the group, also for such specimens for illustration; as the aim in the final monographic work is to illustrate, so far as practicable, each stage of each species, the earlier stages to be drawn enlarged to the same proportions as the full-grown larva, or larger, when the details need such enlargement.

I have given below a list of the species and genera of which I would like the eggs or larvæ in different stages, and I venture to indulge the hope that my friends will co-operate in rendering the work as complete as possible—for without such aid no single person can hope to make such a work at all complete or satisfactory.

Should any one rear any of these Bombyces, with a view to publication, I should be greatly obliged for alcoholic specimens of the eggs and different larval stages, which might be sent after such descriptions were published. Such specimens would be carefully kept and returned. It will only be by such co-operation that we shall arrive at a fair knowledge of the transformations of this extensive group.<sup>1</sup>

# LIST OF DESIDERATA IN THE COMPLETION OF THE LIFE-HISTORIES OF THE PRINCIPAL GENERA OF BOMBYCES AND ZYGENIDÆ.

## NOTODONTIDÆ.

*Gluphisia lintneri*, *danbyi*, *ridenda*, and any other species of this genus except *trilineata*, eggs and larvæ of any age.

*L. phodonta angulosa*, " " "

*Datana ministra* and other species, " " "

*Notodonta stragula*, young larva.

*Nerice bidentata*, eggs and larvæ in all stages.

*Seirotonta bilineata*, eggs and young larva (stages I-IV).

*Heterocampa marthesia*, eggs and stages I-II.

" *guttiritta*, eggs and stage I.

" *obliqua*, eggs and all stages.

" *subalbicans*, eggs and earlier stages.

*Litodonta hydromeli*, eggs and larvæ in all stages.

*Cerura aquilonaris*, " " "

" *scitiscrupta*, " " "

" *multiscrupta*, " " "

## CERATOCAMPIDÆ.

*Sphingicampa*, any species but *bicolor*, eggs and larvæ in all stages.

*Citheronia sepulchralis*, " " "

## SATURNIIDÆ.

*Saturnia galbina*, eggs and larvæ in all stages.

" *mendocino*, " " "

*Plutysamia ceanothi*, " " "

---

<sup>1</sup> It is earnestly hoped that any one receiving this article will kindly reciprocate by sending the eggs and larvæ of whichever of the following moths they can, packed in tin boxes, to the author at Providence, R. I., or during July and August, at Brunswick, Maine.



## HEMILEUCIDÆ.

*Hemileuca maia*, eggs and larvæ in all stages.

|                                |                  |   |   |   |
|--------------------------------|------------------|---|---|---|
| "                              | <i>juno</i> ,    | " | " | " |
| "                              | <i>yavapai</i> , | " | " | " |
| <i>Euleucophæus tricolor</i> , | "                | " | " | " |
| <i>Hyperchira pamina</i> ,     | "                | " | " | " |
| <i>Coloradia pandora</i> ,     | "                | " | " | " |
| <i>Quadrina diazona</i> ,      | "                | " | " | " |

## COCHLIOPODIDÆ.

*Isa (Sisyrosea) inornata*, eggs and young larva.

|   |   |   |   |   |
|---|---|---|---|---|
| <i>Limacodes scapha</i> ,   | " | " | " | " |
| <i>Phobetron pithecium</i> ,  | " | " | " | " |
| <i>Monoleuca semifascia</i> , or any other species, eggs and young larvæ. |   |   |   |   |
| <i>Euclea pænulata</i> ,  | " | " | " | " |
| <i>Parasa chloris</i> ,   | " | " | " | " |
| <i>Packardia elegans</i> ,  | " | " | " | " |

## PLATYPTERICIDÆ.

*Prionia bilineata*, eggs and larva in all stages.

## LASIOCAMPIDÆ.

*Thauma ribesii*, eggs and larva in all stages.

|   |   |   |   |   |
|---|---|---|---|---|
| <i>Gloveria arizonensis</i> ,   | " | " | " | " |
| <i>Gastropacha americana</i> , and other species, eggs and larva in all stages. |   |   |   |   |
| <i>Clisiocampa constricta</i> , eggs and larva in all stages.                   |   |   |   |   |
| " <i>strigosa</i> ,   | " | " | " | " |
| " <i>erosa</i> ,  | " | " | " | " |
| " <i>fragilis</i> ,   | " | " | " | " |
| <i>Artace punctistriga</i> ,  | " | " | " | " |
| <i>Tolyte velleda</i> ,   | " | " | " | " |
| <i>Tolyte laricis</i> ,   | " | " | " | " |

## LIPARIDÆ.

*Parorgyia achatina*, eggs and larva in all stages.

|                       |   |   |   |   |
|-----------------------|---|---|---|---|
| <i>Laria rossii</i> , | " | " | " | " |
|-----------------------|---|---|---|---|

## ARCTIIDÆ.

*Nemeophila*, any species, eggs and larva in all stages.

|                      |   |   |   |   |
|----------------------|---|---|---|---|
| <i>Kodiosoma</i> ,   | " | " | " | " |
| <i>Leptarctia</i> ,  | " | " | " | " |
| <i>Antarctia</i> ,   | " | " | " | " |
| <i>Platarctia</i> ,  | " | " | " | " |
| <i>Callimorpha</i> , | " | " | " | " |

## LITHOSIIDÆ.

*Hypoprepia fucosa*, eggs and larva in all stages.

*Crambidia pallida*, " " "

*Clemensia albata*, " " "

*Argyrophyes cilicoides*, " " "

*Crocota*, any species, " " "

*Emydia ampla*, " " "

*Ameria unicolor*, " " "

*Euphanessa mendica*, " " "

*Cisthene subjecta*, " " "

## ZYGÆNIDÆ.

*Cydosia aurivitta*, eggs and larva in all stages.

*Anatolmis grotei*, etc., eggs and larva in all stages.

*Lycomorpha pholus*, etc., " " "

*Pyromorpha dimidiata*, " " "

*Triplocris smithsonianus*, " " "

*Harrisina americana*, " " "

*Acoloithus falsarius*, " " "

*Gnophæla vermiculata*, etc. " " "

*Ctenucha ochroscapus*, " " "

*Scepsis fulvicollis*, etc., " " "

*Syntomeida ipomece*, " " "

*Cosmosoma omphale*, " " "

*Ciris wilsoni*, " " "

*Psychomorpha epimenis*, " " "

*Edwardsia brillians*, " " "

*Alypia mariposa*, etc., " " "

*Pseudalypia crotchii*, " " "

## FAMILY PLATYPTERICIDÆ.

Notes on the early stages of *DRYOPTERIS ROSEA*.

The final stage of this species was described in my paper, "Life-history of *Drepana arcuata*" (Proc. Bost. Soc. Nat. Hist., xxiv, 489), and since then Mr. Bridgham has reared it from a *Viburnum* (probably *V. lentago*), the smallest larvæ occurring in Providence in the second week in July, and representing the vernal or spring brood. He has made excellent colored figures, from which we draw up the following descriptions.

Compare also Mr. H. G. Dyar's descriptions in *Psyche* v, 421,

and vi, 179. He thinks there are six stages, and that it hibernates in the 4th or 5th stage.

*Stage II?*—Length 7 mm. Feeding on the ends and also eating very ragged holes out of the side, so that the young brown larva closely mimics the ragged portions projecting from the edge of the hole; the tail could be easily mistaken for one of the lower filaments of the withered edge of the leaf. Head as wide as the body, with two large rough finely tuberculated conical processes on the vertex; they are more conical than those in the next stage. There are two smaller dorsal tubercles on the prothoracic segment, and a single large flattened rounded one on the 3d thoracic segment. The body tapers slowly from the 1st thoracic segment to the tail. The skin is rough, with four transverse rows of fine granulations on each segment, and the body is pale brown, like a withered leaf, while the tail, which is now simple, straight, though spinulated, is scarcely twice as long as the body is thick on the 5th abdominal segment.

*Stage III.*—July 14. Length 10 mm. The body and the proportion of the tail and the shape of the tubercles as before, but the body is darker than before, and the tail is now concolorous with the body. This stage corresponds to the dark brown hibernation-stage of the autumn brood of larvæ.

*Stage IV.*—July 18. Length 16 mm. In this stage the characteristics of the last one are assumed, though the tail is still straight, but with two paler long rings, the base and tip being darker. The head narrows above and ends in two conical tubercles which are not rough as before; it is dark in front, with a distinct V-shaped yellow clypeal spot. The body is brown, with a broad paler dorsal stripe, which encloses the stout short tubercle on the 3d thoracic segment, and contracts on the 3d and 4th abdominal segments. There are two parallel oblique pale brown lateral stripes, the front one beginning at the base of the 3d thoracic legs and extending upwards and backwards to the hinder edge on the back of the 1st abdominal segment; the second one of the same length and blending with the dorsal stripe on the back of the 3d abdominal segment.

The last stage (length 22 mm.) was attained July 23d. It differs from the preceding stage chiefly in the paler head, without the conspicuous yellow spot, and in the tail being swollen in the middle and slightly at the end.

*Late summer brood.*—Several larvæ were kindly sent me by Mr. Tallant, from Columbus, Ohio, September 10; they were found

feeding on the haw. They did not molt or grow, and undoubtedly the species hibernates in this stage.

*Stage II or III.*—Length 6 mm.; of the tail 2 mm. The head is as wide as the body in the middle, the skin rough and warty; the vertex ending in two high conical tuberculated protuberances which rise high above the level of the prothoracic segment. The head is smoother in front than on the sides, being freer from the tubercles; it is of the same color as the body, but the two protuberances on the vertex are paler than below, corresponding to the lighter more ashen hue of the upper side of the body. The 1st thoracic segment with the front edge considerably raised and thickened, bearing two sharply conical warted tubercles about one-half as large as the two on the head and situated directly behind them. The 1st is not quite so wide as the 2d thoracic segment, but it is slightly wider than the abdominal segments, which are all of the same width as far as and including the 6th, when the body gradually tapers to the tail, or tail-like suranal plate which forms a long cylindrical appendage gradually tapering to the rather obtuse end; it is tuberculated like the rest of the body, and a little darker in some specimens; it is as long as abdominal segments 3 to 6 taken together. The skin of the body is coarsely tuberculated, forming whitish close-set granulations; the segments are transversely wrinkled, four wrinkles to a segment, in the middle of the body. On top of the 3d thoracic segment is an irregular rounded knob or tubercle, the surface of which is granulated, but not differing in color unless a shade darker. At the base of both the thoracic and abdominal legs are short stiff depressed hairs. The color of the entire body, including the legs, is of a uniform dark walnut-brown.

#### FAMILY PSYCHIDÆ.

The larva of *LACOSOMA CHIRIDOTA* Grote.

I am indebted to Mr. James Angus, of West Farms, New York, and to Miss Caroline G. Soule, of Brookline, for the material (sent in September) from which the following description has been drawn up. See also Dr. Riley's notes on this caterpillar.<sup>1</sup> Mr. Angus

<sup>1</sup> Fifth Report U. S. Entomological Commission, on Insects Injurious to Forest and Shade Trees, by A. S. Packard. See (p. 141) Riley's notes on its habits, and his description with my description of his alcoholic specimen.

writes me that his larvæ occurred on the swamp oak. Though belonging to the Psychidæ, both in their larval structure, as well as their cases, and the characters of the moths, the two American genera *Lacosoma* and *Perophora* differ remarkably from the normal members of the family. The larvæ of both genera live upon the oak.

In the present form the case is made by simply folding over one oak leaf on each side of the midrib, so that it is flat, one edge being thin, and the other full and thick. It is difficult to dislodge the caterpillar from its roomy sack, and in this respect it is just the reverse in its habits from the ordinary leaf-rollers; this is perhaps due to its heavy and highly modified body, since if it had to leave its case and drop to the earth, it would perish. Still it can readily turn around within its roomy case. It is, as Riley states in his brief description of the habits of *Perophora melsheimerii*, like the latter "active and savage," as when I attempted to draw it out of its case it would vigorously bite at the end of my forceps, an unusual trait in caterpillars. On finally removing it from its case without injury it was very sluggish and did not stir while I was examining it. I put it back in the box in which it was sent, and in the course of an hour it had found its case, and had sewed up and mended the side of its case which I had to open in order to draw it out without injuring it, as it promised to be a difficult task to remove it without rupturing the body.

The special and striking adaptation of this larva to its life in a loose case, which shows that it, with *Perophora*, is a stem-form, connecting the normal Psychidæ with ordinary Bombycine caterpillars, is seen in the following points:—

1. The obsolete dorsal lines and stripes of the middle of the body, this portion not being occasionally exposed to the light, as are the head- and tail-end. This plainly indicates the origin of this form from a larva which may have fed on leaves, whose body was continuously striped from head to tail, and which had the general habits and mode of ornamentation of larvæ, for example like those of the Phycitæ, which are more or less chestnut-brown, striped with darker, and which live among leaves or masses of their castings, and which live partly shut up from the light. The cause, then, of the atrophy of the normal markings is the absence of light.

2. The small middle abdominal legs, which owe their reduction in size to disuse. In this respect this larva connects the apodous Psychid caterpillars with normal ones.

3. But the most striking adaptive features are: (a) the peculiar shape of the head, and also (b) of the suranal plate, both being steeply inclined planes, and both serving as stoppers to close each end of the case; both being broad, rounded, and the surface not only sloping, but also so colored as to cause it to be easily confounded by the observer with the exterior of the sack. This is an adaptation in direct relation to the form of its case, and must have been due to the transmission of acquired characters during the lifetime of its ancestors, after they had begun to construct cases.

4. The body so flattened that the spiracles can be seen from above.

Its case is not so regular in form as that of *Perophora*; it is quite irregular on the edges, the midrib on one side projecting in front and behind; it is about an inch long and three-quarters of an inch wide.

*Full-grown larva* —Length 25 mm. (one inch). The head and body are somewhat flattened, so that the spiracles can be seen from above. The head is large, broad, and flattened, the dorsal surface forming a rather steeply inclined plane, like that formed by the dorsal surface of the suranal plate. The surface of the head is rough and corrugated. It is pale yellowish clay-brown (luteous), mottled with dark brown on the side; but in the middle and in front dark brown. The mandibles are dark brown, very solid and thick at the end. The antennæ are normal. There are no traces of the remarkable bulbous appendages characteristic of *Perophora*. The labrum is dark brown. The head is as wide as the prothoracic segment, which is narrower than the rest of the body. The 2d and 3d thoracic segments increase in breadth, while the body is thickest just behind the middle, not decreasing in width until the 8th segment. The end of the body is broad and rounded. The suranal plate is large, broad, and well rounded behind; with the surface slightly convex and considerably inclined so as to form a close stopper for the posterior opening of the case; on the dorsal surface are two quadrant-shaped rough semi-chitinous pale, parchment-like areas, provided with a few whitish hairs arising from minute warts.

The body is smooth, nearly hairless, the minute setæ being short, erect, blunt at the end, the two largest ones being situated on the 9th abdominal segment. The body is flesh-colored above and slightly luteous or clay-yellow on the sides; the body in my specimen was not quite so dark as Riley describes. The spiracles are conspicuous, black-brown, pale in the middle. The dorsal surface of the pro-

thoracic segments is occupied by a large subchitinous plate, with a pale median line, bordered on each side by a dark shade, also followed on each side by a broad dark band, which is continued on to the two hinder segments, and becomes on the 1st abdominal segment split into two faint lines. This line on the prothoracic segment is succeeded by two oblique dark stripes, the lower one situated just above the spiracles, and twice as long as the upper of the two. The dorsal surface of the abdominal segments with four diffuse obsolete dusky stripes, not reaching the 7th and 8th segments, but on the 8th and 9th segments and on the suranal plate, these lines reappear again (since this end as well as the front end of the body is often exposed to the light) and form two parallel much broken and irregular bands which make a chain of about six pairs of dusky spots. The two subdorsal bands are much broader, and each form a series of about six dusky irregular spots; the lower line partly including the 8th spiracle. There is a broad dusky band on each side of the thoracic segments, at the base of the legs. The middle abdominal legs are very short, but the hooks are very numerous and form two complete alternating circles; the anal legs are much larger than the others, and are also pale. The thoracic legs are dusky amber in color, the general effect however being pale.

The larva is fierce and courageous, and its unusual shape adapts it for resisting the attacks of birds which might endeavor to draw it out of its case. When attacked from behind, it will turn around quickly in its case and present its hard head to receive further attacks; its jaws being unusually solid, with a thick cutting edge. Moreover, even when seized, it can shorten and dilate the body, so that when seized by forceps or by the bill of a bird it can prevent or hinder its assailant from pulling it out of its case.

#### The larva of *PEROPHORA MELSHEIMERII* Harris.

Several specimens were received from Prof. Otto Lugger, of St. Anthony's Park, Minn., where it seems more common than in southern New England. His specimens were received September 13th, and being kept in a warm room they mostly pupated, and a male issued from the case October 31st, and a female November 4th. She laid from 75 to 80 eggs.

*Egg*.—Length 1.7 mm.; diameter 0.7 mm. Long and slender, cylindrical, slightly curved; both ends alike. They are fixed by one end, adhering by a gluey mass to the surface on which they

are deposited. The shell is ornamented with a longitudinal series of parallel fine delicate ribs, between which are cross ribs, parallel and very near together; on the upper (micropylar?) end of the egg are faintly marked, rude, slightly raised polygonal cells, and at the extreme end is a group of more raised smaller areas. Color yellow.

It will be interesting to examine the freshly hatched larva, and I should be greatly obliged for a lot of fertilized eggs.

*Young larva.*—Length 9 mm. It is now of the same general shape and colors as the full-grown worm. The head is dark chestnut, as is the now well-developed prothoracic shield. The shape and pale color of the end of the body are as in the fully-grown worm.

The case is at this time very irregular, much more so than that of the fully-grown larva; it is lined with silk, with which the "frass" or casting are somewhat intermixed.

The case of the worm in the last stage is about an inch and a quarter long, and half an inch wide; it is flattened cylindrical, and formed of two leaves properly trimmed and sewed together; the midrib of each half extending along near the middle of each surface. Each end of the case is closed after preparation by an orbicular flat silken lid, fastened all around.

*Full-fed larva.*—Length 30 to 38 mm., when retracted about 15 or 20 mm. The head is large, about as wide as the prothoracic segment; somewhat flattened in front on the face, which forms a declivity adapted to form a stopper to the opening of its sack; the cuticle is dense black, deeply rugose and corrugated, especially on each side of the clypeus; the region of the vertex is rough and coarsely punctured, but without the irregular furrows of the anterior region or face. The mouth-parts are all black; the mandibles unusually thick and strong, and rounded on the cutting edge. The antennæ are very extensile, long, thick, and well developed. But this larva is especially remarkable for new structures not known to exist in any other caterpillars, viz., a pair of long appendages, the use of which is quite unknown. They arise by a slender stalk behind and a little above the eyes, on each side of the head; the base is cylindrical, but the appendage soon becomes flattened or compressed, and flattened bulbous at the end. The structures are brittle, not flexible, and they easily break off; they are about as long as the head.

The prothoracic segment is dorsally black-brown, solid, chitinous, thick, smooth and shining, forming an unusually solid shield, which



is crossed by fine impressed lines; there is a pale median line. The 2d and 3d thoracic segments are slightly wider than the prothoracic. The abdominal segments gradually increase in width to the end of the 8th segment. The skin is covered with coarse and dense granulations, and in general is of a dark brown walnut-color, but paler on the 2d and 3d thoracic and 1st and 2d abdominal segments, these being dull flesh-colored, and faintly showing two parallel dorsal and two wider subdorsal dark-brown stripes, which become obsolete on the 3d and succeeding abdominal segments. The whitish granulations are less dense on the 3d and succeeding segments than on the front or striped portion of the body.

The terminal segments of the body are singularly modified; when retracted the body is thickest in the region of the 5th and 6th segments, but when extended to its full length the 8th abdominal segment is as wide as any; the hind edge of this latter segment is raised into a high, thick, pale flesh-colored fold, which takes the place of the suture between the 8th and 9th segments. The 9th segment is remarkably large and specially modified, having a sublunate dorsal surface, and separated by a slight, sometimes well-marked, ridge from the suranal plate; this ridge is not directly transverse, but is composed of three curvilinear portions, a middle and two lateral ones. The suranal plate is not quite so wide as the 9th segment, but very large, broad, rounded, with the edge a little thickened and the surface rapidly sloping downward and backward; the surface of this (10th) and the 9th segment taken together form an admirable and perfect stopper, or back door, closing the end of the case. The skin on this portion is (evidently from frequent use) dense and thickened, and further strengthened by the granulations, which all over the 9th segment and the suranal plate are densely crowded, extending on to the middle of the upper or dorsal surface of the 8th segment. This portion of the 8th segment is pale flesh-colored (without any rosy or pink tint) and is concolorous with the pale hue of the 9th segment together with the 10th, or suranal plate. The impressed lines and punctures of this region are more or less blackish.

The body beneath on the anterior half is dark brown, becoming paler behind. The thoracic legs are black; the abdominal ones of the same color as the segments bearing them, with the addition of a slight reddish tint and with a chitinous light pitchy piece above the plantæ. On top of each thoracic segment are two dark minute

piliferous warts, but on abdominal segments 1 to 7 are four piliferous warts arranged in a trapezoid, and they are black, flattened, and more or less radiate in appearance.

The body is not quite so much flattened as in *Lacosoma*, so that the spiracles are not so distinctly seen from above as in that genus; they are black, those on the 8th abdominal segment about one-third larger than those on the 7th segment, and they are more easily seen from above.

Compared with *Lacosoma*, *Perophora* differs in the presence of the singular appendages of the head, in the broader, flatter, more inclined face, the perfectly black prothoracic shield, which in *Lacosoma* is banded, and is not black and opaque; in the presence of whitish granulations, *Lacosoma* being without any; in the 9th abdominal segment being without any suture, but on the contrary having a ridge instead, where in *Lacosoma* the 9th segment is normal, being separated by a well-marked suture from the 8th segment, and also separated by a suture from the suranal plate. In *Perophora* the suranal plate is more highly specialized and modified, broader, and granulated. Also the bands on the end of the body of *Perophora* are entirely effaced, while they are retained in *Lacosoma*.

Thus *Lacosoma* is, as regards the larval characters, the less modified genus, and is more like the larvæ of the normal *Psychidæ*, such as *Æceticus* and *Thyridopteryx*.

As the females of the two genera mentioned are winged like the males, they are evidently in this respect, as well as in the larval characters, less modified and more generalized *Lepidoptera* than the true *Psychidæ*, and they should for these reasons be referred to a distinct subfamily of the group, which may be called *Lacosominae*.

The adaptational characters of *Perophora* are the following:—

1. The large, solid, dark head serving to stop up the anterior entrance to its case.

2. The consolidation of the 9th and 10th abdominal segments, the entire dorsal surface forming a solid, firm, oblique surface to close the posterior, or, in fact, either opening of its case, and thus to resist the attacks of insectivorous birds.

3. The wonderful power of shortening its body and thus dilating it so as to enable it to retain its hold in its case and prevent its being drawn out by birds.

4. Its stout jaws enable it to bite firmly.

5. Its unusually fierce and courageous disposition, undoubtedly

developed as the result of successfully withstanding the attacks of birds.

*Pupa*, ♂.—Length 12 to 13 mm. It is moderately stout, and differs considerably from the normal shape. The head is armed with two stout curved high prominent ridges, converging in front and nearly meeting and almost touching the apex of the raised very distinct clypeus. On the prothoracic segment is a high thin median dorsal ridge; the continuation of it on the rest of the thorax is low, but rather more marked than usual. The sutures between the six basal abdominal segments form deep dorsal furrows, the front edge of which is raised, with a row of teeth projecting over the furrow, the hinder edge of which is toothed, but the teeth form rather long straight ridges. The end of the body is blunt or docked, and armed with four small spines on each side, two of them on the outside near together. On the surface of the 9th segment are a few minute sharp spines. The head and thorax are a little darker than the abdomen, the body in general being of the usual chestnut or mahogany-brown.

Notes on the habits of the newly-hatched larva of  
*THYRIDOPTERYX EPHEMERÆFORMIS*.

The habits of the freshly-hatched larva of this insect have already been well described by Dr. Riley in his Bulletin No. 10, Division of Entomology, on Shade-tree Pests, U. S. Dept. Agr., Washington, and the following observations may serve to supplement his.

From eggs kindly sent me by Dr. Riley, the larvæ hatched in a warm room April 17th; they were found late at night, 11 o'clock, in large numbers in a box on my study table and had eaten little holes in the cloth covering. On the next morning some of them had begun to make hat-like loose cases of the bits of cloth and paper. One in particular, enclosed in a corked vial, had bitten out rather large round mouthfuls or pellets of the cork and fastened the bits together by silken threads, forming a loose sheet or rug-like mass, in which the larva rolled about so as loosely to attach itself to the silken threads, the mass forming a rude band encircling the end of the body. One was seen to lie on its back in a rude heap of the cork pellets, and by rolling over in it had formed a wide girdle or loose band which nearly met around the body, the gap across the metathoracic tergite being filled up in three or four minutes more by three or four bits of cork (see Riley's Fig. 8, *c*, *d*); during this process the little restless creature would lie on its back

and sometimes on its side, occasionally stopping to bite out with its jaws additional pieces of the cork.

They apparently do not take food until their case is completed. In ten minutes this narrowest part on the back of the thorax was three times as wide as at first, there being three rows of chips, the case being nearly half completed in about half an hour.

During this operation the head constantly moved to and fro, the labial spinneret giving out the silk thread, and fastening the cork pellets together, the insect stopping now and then to bite off new pieces of cork.

In 26 minutes from the time the band was bridged over by one pellet, the case was so far completed that only the end of the body projected out of it, and now instead of lying down on its side or back, the tail or end of the short body was held more or less erect, and was either withdrawn or pushed out, the basket-like case being built out or added to on the anterior edge. I could finally see the edge of the hole at the bottom of the basket drawn in by the crotchets of the anal legs. To steady itself it would extend and withdraw the terminal half of the body while completing the case.

In walking the third pair of legs are both moved together simultaneously, like a fork, and are extended forwards as if all of one piece, thus propping up the body, while the two anterior pairs are moved.

In one hour it had begun to walk around the end of the cork, having been previously busied with making its case. I should estimate that in general it requires between one and two hours for a larva of this age to construct its basket.

#### FAMILY LIPARIDÆ.

##### The life-history of *ORGYIA ANTIQUA* (Linn.).

The eggs, kindly sent from Salem, Mass., by Miss Mary Nichols, hatched May 15th. The larva was described May 18th. The second molt took place the morning of the 22d, the third molt on the morning of May 26th; the molts being nearly simultaneous in the brood. I fed it on Wisteria, at Providence, R. I.

*Egg*.—Length .8–1 mm. Short, broadly cylindrical. The upper end which the larva breaks off on hatching is depressed or crater-like with a thick swollen edge around it. The surface under a triplet is seen to be not very highly polished and closely pitted,

and under a  $\frac{1}{2}$ -inch objective the shell is seen to be coarsely, deeply and irregularly pitted, the hexagonal shape of the edge of the pits being nearly effaced. The larva often after hatching eats more or less of the shell.

*Larva, stage I.*—Length 4 mm. Head black, two-thirds as wide as the body. The prothoracic segment is as wide as the body behind; it is black above in the middle; on each side is a large reddish-ochreous tubercle directed obliquely outward and giving rise to about twelve long, mostly blackish (a few gray) hairs, which, like all the others, are finely spinulated. The other two thoracic segments are pale flesh-colored with a whitish tint, with a transverse row of blackish-brown piliferous warts, of which the two in the middle are much smaller than the one on each side. Abdominal segments 1–4 dark varnish-brown, with large dark piliferous warts; segment 5th colored like the 2d and 3d thoracic, being whitish-greenish pale carneous, with two minute but conspicuous piliferous warts. The three following segments with the general color, tubercles, and hairs as on abdominal segments 1–4. On segment 8 is a roundish dark dorsal patch enclosing two dorsal blackish piliferous warts, the skin bordering the patch being reddish-carneous. The lateral row of black hairs and those at each end are about three-fourths as long as the body; the longest hairs, a pair on each segment, arise from the sides of the prothoracic and 8th abdominal segments. The eversible glands in this stage are not noticeable and are not seen unless attention is specially called to them; only the one on the 6th abdominal segment is to be distinctly seen, that on the 7th segment is less apparent and not bright colored. Duration of the stage 7 to 8 days.

*Larva, stage II.*—Length 6–8 mm., varying somewhat in size. Head black. The two lateral prothoracic tubercles are now very large, pale coral-red on the basal two-thirds, black at the end, the hairs arising from them are black. On the top between the tubercles is a large black patch. The top of the 2d thoracic segment is whitish, but the small dorsal tubercles, which are unequal in size, are dark. The top of the 3d thoracic segment is pale, whitish, bordered with ochreous, and bearing small pale piliferous warts. Abdominal segments 1–4 are velvety black on the back, edged with a narrow ochreous line, each segment bearing two large black piliferous warts. The body is now a little humped over the 1st and 2d abdominal segments. The 5th segment is yellowish-white above,

with piliferous warts of the same size. Behind this segment the body above is blackish, with a subdorsal line on each side, which unite on the 9th segment, which is above pale ochreous. The body beneath is livid. The thoracic legs are blackish, the abdominal legs pale livid. Many of the dorsal thoracic and lateral abdominal hairs are pale gray. *The two eversible glands are now bright coral-red, as bright colored and as distinct as in the final stages.* At the end of this stage, just before the molt, there are visible a few feathery black hairs on the inner side of the two dorsal tubercles of the 8th abdominal, and in some individuals they are present on the inner side of the dorsal tubercles on the 1st and 2d abdominal segments.

*Larva, stage III.*—Length 10 mm. At first the larva is scarcely larger than in the preceding stage just previous to molting. The head is black as before. The lateral prothoracic tubercles are pale Indian-red with black between them, *and give off a pencil of pume-like hairs, thickest at the end.* This and the other pencils are as well developed proportionally as in the full-fed larva. The top of the 2d and 3d thoracic segments white and edged with ochre as before. *The four median dorsal tufts, one each on the four basal abdominal segments, are now well developed, the two in front being dark smoky-brown, the two behind snow-white, the 4th one being somewhat smaller than those in front.* The 5th segment is white above, ochreous on the side, as in stage II. *The 8th segment bears a thick long tuft of black feathery hairs, as well developed in proportion as in the adult.* The row of largest lateral tubercles is now conspicuous, *the warts being bright flesh-colored* instead of black, as before. The hairs, especially along\* the sides of the body, are denser, more numerous, than before.

Note.—Two days later, in a few, the two anterior dorsal median abdominal tufts have faded almost white, while the two posterior are straw-yellow. In most, however, the two anterior tufts remain black, the two posterior ones having changed to straw yellow. Length of stage about 5 days.

*Stage IV.*—Molted May 31st, some as late as June 1st. Length 17 mm. The chief change is that each of the four dorsal tufts has now become pale buff-yellow, though immediately after molting the two anterior tufts are at first dusky, gradually becoming paler. The subdorsal rows of these tubercles on each side are coral-red, and the upper lateral row of piliferous warts are now bright coral-red, while lower down there is a small bright yellow dot, one on each segment

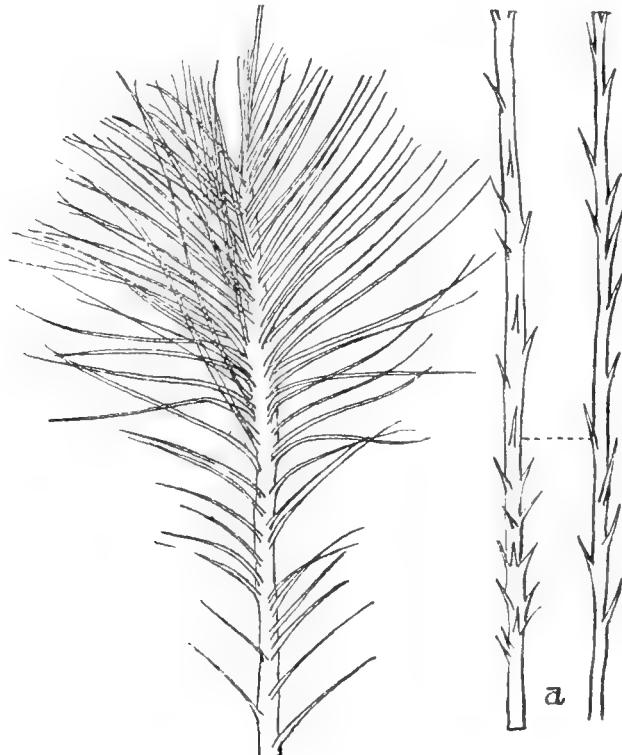
between the piliferous warts. A small slender white lateral pencil on 3d thoracic segment, and a thicker black one on 1st abdominal segment of about the same length. The other black pencils are a little longer than before. The 2d and 3d thoracic segments have a pair of small dorsal yellow transverse slashes on each side, and the dorsal tubercles on these two segments are bright yellow and very conspicuous. The prothoracic piliferous tubercles are still bright Indian-red. The lateral pale hairs along the body are whiter and denser than before. The head is black, not coral-red as in *O. leucostigma*.

June 7th several began to spin a cocoon (♂?). June 8th, 4 or 5 cocoons. The ♀ larvæ were still molting June 14th; none yet in cocoon; I think the ♀ larva must molt oftener than the ♂.

Variation in the four dorsal tufts of last stage: Some are all cream-white, others are buff-yellow, in others the 2 anterior dusky, and 2 posterior buff-yellow, and in one specimen of the 2 anterior tufts, one is dusky and the 2 posterior are snow-white.

Of 12 cocoons, all up to June 15th seemed to be ♂. June 18th, 2 ♂ moths appeared!

Fig. 1.



One of the black plumose hairs taken from a lateral prothoracic tuft is represented at Fig. 1; a, portions of a simple, spinulated hair.

*Recapitulation of appearance of early larval features.*

1. Appearance in stage III of the pencils on the prothoracic and 8th abdominal segments.
2. The four median dorsal tufts on the four basal abdominal segments well developed in stage III.
3. The warts of the lateral row become bright flesh-red in stage III.
4. The two dorsal eversible glands become bright coral-red in stage II. Thus, all the features of the full-grown larva, such as the high colors and the white and black tufts or pencils, which render it so conspicuous, appear in the 3d stage.

The early stages of *ORGYIA LEUCOSTIGMA* (Abbot and Smith).

*Larva, stage I.*—(Drawn up from alcoholic specimens from Dr. Riley.) Length 3.5 mm. The head is small and not so wide as the body. It is deep chitinous or amber-ochreous. The body is rather long and slender, cylindrical, pale yellowish flesh color, with two broad irregular, dark, more or less broken subdorsal lines, which are most distinct on the abdominal segments, the space between the lines being sometimes irregularly bridged over by offshoots from the main lines.

The 1st thoracic segment is slightly wider and larger than those behind it, but looks larger than it really is from the pair of very large lateral piliferous tubercles which cause the larva to resemble that of a *Clisiocampa* or rather a *Gastropacha*. These tubercles are large, prominent, and rounded, bearing about 20 spinulated hairs of varying length, the longest being about two-thirds as long as the body. All the hairs are brown, some being paler and taper to a point. There are no clavate hairs on the body. The piliferous tubercles on the 2d and 3d thoracic tubercles corresponding to the lateral prothoracic ones above described are slightly smaller than those on the succeeding or abdominal segments; the latter, *i. e.*, the subdorsal ones arising from the dark subdorsal lines, all being of the same size. The two subdorsal lines run between two rows of tubercles, the inner row being one of the two dorsal median rows; the tubercles of these two median rows are much smaller than the outer rows, the latter set being a continuation of the large prothoracic "lateral" ones. Now those of the two medio-dorsal rows are small in front, but become larger on the 6th, 7th, and especially the



8th abdominal segment, giving a slightly humped appearance to this segment, from which the body falls off to the anal tip. There is no prothoracic shield.

The rudimentary eversible glands are difficult to detect. I can not with a Tolles triplet or  $\frac{1}{2}$  in. objective detect them on the 6th and 7th segments. They must be rudimentary and much smaller than any of the tubercles and must be colorless.

It will be observed that in this stage when the larvæ are small, they show none of the markings of the later stages, not needing the danger signals, though they are undoubtedly thinned out at this time by insects and birds.

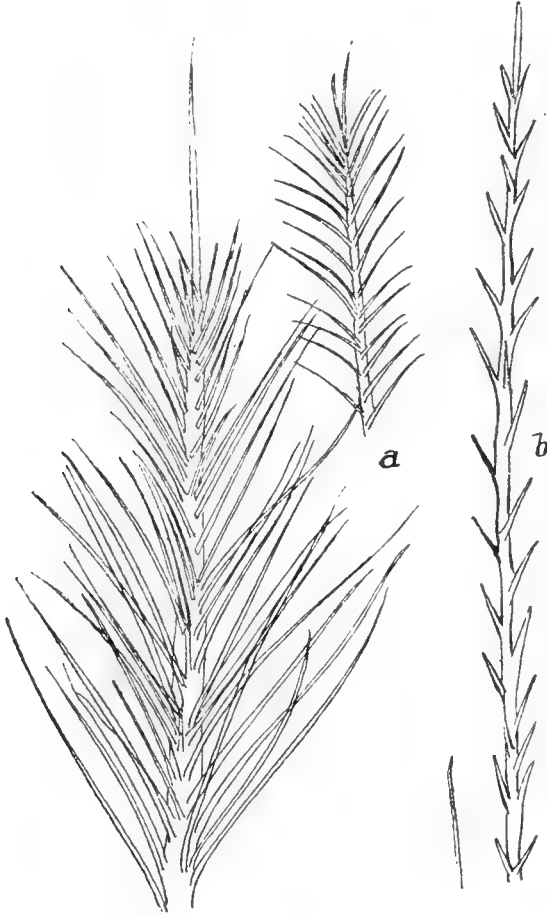
*Stage II.*—(Found on Wisteria, June 15th.) Length 5 mm. Head not so wide as the body. Prothoracic segment very wide, with two very large prominent lateral tubercles extending out as far as the front of the head, and each bearing a short black pencil which is not so long as the body is wide. Yellow hairs project over the head from the front edge of the prothoracic segment; they are unequal in length, the longest ones being nearly as long as the worm itself. The body is blackish, *the lateral black line of stage I being now very broad; connected by a black band on the hinder edge of the prothoracic segment*, while the end of the body is black above and encloses *the two retractile pale yellowish papillæ*. From the 2d thoracic to the 5th abdominal segment extends *an irregular broad yellowish band* ending in a broad squarish, yellowish patch, free from papillæ, and situated on the 5th abdominal segment. The front edge of the 1st thoracic segment is luteous. The sides of the body low down and beneath are greenish, with a faint yellowish tinge.

*Stage III.*—(Observed June 17th.) Length 6–7, and at end of stage, 10 mm. *It has now assumed the characters of the last stage.* The head is at first amber-colored, afterwards deepening. *There are two dark pencils  $\frac{1}{3}$  as long as the body, and 4 white tufts, one each on the first four abdominal segments. The two eversible glands are now coral-red.* A velvety-black dorsal band extending from and enclosing the white tufts to the end of the body. The sides of the body are of a peculiar bluish-gray. *A dense anal tuft arises from the 8th abdominal segment, giving rise to feathered hairs like those on the full-fed larva, but not so well developed.* Most of the other hairs are whitish, some of them dark.

Fig. 2 represents the end of a black plumose hair from a prothoracic tuft in the last stage; *a*, a similar hair of stage III, showing

the simpler shape, with much fewer plumules; *b*, the end of an ordinary spinulated hair.

Fig. 2.



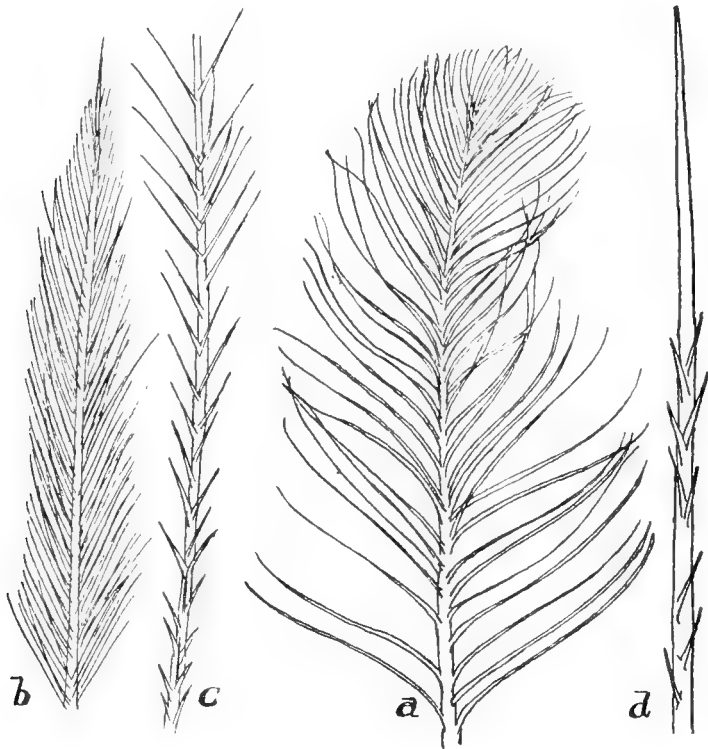
For comparison a plumose hair of *Parorgyia parallela* is represented in Fig. 3; *a*, a hair taken from the dorsal tuft on the 8th abdominal segment; *b*, a very long and slender hair from a prothoracic tuft; *c*, the base of *b*; *d* a spike-like spinulated seta intermingled with the plumose hairs of the dorsal tuft.

*Recapitulation of the more salient ontogenetic features.*

1. The two dorsal eversible glands become bright coral-red in stage III.
2. Appearance in stage III of the lateral prothoracic pencils, and of the 4 dorsal abdominal tufts.
3. The dense dorsal tuft on the 8th abdominal segment, consist-

ing of feathered hairs, is well developed in stage III, though not so large in proportion as in the final stage.

Fig. 3.



Notes on the transformations of *ORGYIA CANA* Hy. Edwards.

Mr. Dyar has already given a detailed description of the life-history of this species in *Psyche*, VI, No. 189, January, 1892. He describes seven larval stages. The following notes are based on a brood hatched from eggs kindly sent me by Mr. Dyar from the Yosemite Valley, September 25th; they hatched in Providence on the 30th of the May following, and fed on young tender oak leaves. I publish them as they contain references to the glandular hairs and a few points not noticed by Mr. Dyar.

*Larva, stage I.*—Length 3 mm. Head, body, and hairs all black, except the hairs situated low down on the sides, where they are gray. The pair of lateral piliferous tubercles on the sides of the prothoracic segment is very distinct and prominent. All the hairs (except those low down on the sides of the body, where they are gray) are black, and of the same general length as in the freshly hatched larva of *O. leucostigma*. Two days after hatching the body is

slightly longer and somewhat paler, especially on the 2d and 3d thoracic segments, and on the 5th, 6th, and 7th abdominal segments, but the piliferous tubercles are black, and contrast with the livid black color of the segments. The dorsal tubercles on the 5th, 6th, and 7th abdominal segments are situated on a pale straw-yellowish field, as seen under a  $\frac{1}{2}$ -inch objective.

The shorter hairs on these three abdominal segments bear and are enveloped by drops of a clear fluid; but these drops were not seen on the hairs of the other segments.

I was unable to detect on the living larva placed under a  $\frac{1}{2}$ -inch objective the dorsal eversible glands, but I could see five or six bulbous pediculate processes, which are most numerous on the back of the 7th abdominal segment. The fluid envelops the hairs, and is evidently exuded from them; on the other hand, the hairs situated on the other segments both in front and behind do not exude the fluid.

*End of stage I.*—About five days after hatching and just before the first molt. Length 5 mm. The body is now paler than before, livid, and marbled above and on the sides with white, with a yellowish patch on the hind edge of the prothoracic segment, which grows wider backwards covering the back (tergum) of the 3d thoracic segment. On each of the 5th, 6th, and 7th abdominal segments is a dorsal yellowish patch, more distinct than in the early part of this stage. The glandular hairs are as at first, being especially developed on segment 7, where six are seen, and there are no signs of the eversible glands.

*Stage II.*—June 6th. Length 4–6 mm. All the larvæ with two distinct coral-red eversible glands on the 6th and 7th abdominal segments, and the short dorsal black tufts have appeared. The head is still entirely black. The yellow patches on the thoracic and the 5th abdominal segment are as before. The piliferous tubercles are still black, the body dull livid, marbled with dull porcelain whitish. A few white hairs arise from the dorsal surface of the thoracic segments, and a few from the dorsal surface of the 2d and 3d abdominal segments. The lateral tubercles on the prothoracic segment are large and prominent, but there are as yet no long lateral or dorsal pencils, though on the 2d and 3d abdominal segments is a pair of short thick dorsal tufts, but none on the other segments.

On June 7th A. M. the larva had increased to 8–9 mm. in length, and the white hairs were more conspicuous.

*Stage III.*—Molted the second time June 10th. Length 11 mm. Now the pair of prothoracic black pencils formed of feathered hairs, and a short thick dorsal one on the 8th abdominal segment have appeared. Two snow-white dorsal tufts, one on the 3d and a much smaller one on the 4th abdominal segment are now present. The dorsal and subdorsal warts on the abdominal segments are now bright rust-red, and very conspicuous. The body is jet-black, and there are no lateral tufts. The white hairs on the sides of the body are longer and more numerous and dense than before. The generic characters are nearly all assumed at this stage, as in the other species.

*Stage IV.*—June 15th–17th, molted again. Length, without the pencils, 15 mm. The head is still black, with a whitish labrum. There are two long black prothoracic pencils of feathered hairs, and a single median dorsal one on the 8th abdominal segment. Two brown-black tufts on abdominal segments 1, 2, each, succeeded by a white dorsal tuft on the 3d, and one on the 4th segment. The piliferous warts are now brighter red. Most of the hairs are white. The yellow patches on the thoracic and on the 5th abdominal segments are distinct. It is now a gaily marked caterpillar.

*Last stage.*—(July 12th.) Length 18–20 mm. The head is entirely black, except the labrum, which is yellow. The body is black, with faint yellowish patches along the sides, but along the back deep velvety black. A pair of stout prothoracic pencils. No lateral pencils; a thick medio-dorsal oblique black pencil. The head is partly concealed from above by a thin broad sheet of white hairs arching over from the prothoracic segment. There are 4 thick short dorsal black tufts of the usual wedge-shaped form, the outer hairs on the base being white, though the 2 anterior tufts are in one example tawny, and in the centre black, while the two posterior tufts are white, the central hairs being somewhat buff-colored. The piliferous warts are bright brick-red, but not of so bright a coral-red hue as the two dorsal eversible glands. The hairs arising from the piliferous warts are white, with scattered black ones, all, as usual, radiating, and of different lengths. There is a brown and yellow dorsal spot and two unequal subdorsal ones on each side of abdominal segments 4 to 7. There are four flattened broad dorsal piliferous warts on the front edge of the prothoracic segment, and which are reddish-yellow behind. A pair of yellow dorsal spots on the front edge of the metathoracic segment. A broken yellow

lateral line, or rather a series of curved broad bright sulphur-yellow spots each situated on the sutures between the two lateral piliferous warts; these are especially noticeable on the abdominal segments.

*The cocoon.*—One July 10th. It is rather broad and rounded, whitish, with numerous yellow hairs, some white ones, and a few black ones mixed with them. Just where these yellow hairs come from I do not understand, as there are none on the larva, unless they have changed in color since death.

#### The first larval stage of *ORGYIA DEFINITA* Packard.

This stage has already been described by Mr. Dyar in *Psyche*, VI, September, 1891, 145.

They hatched June 19th–21st. The freshly hatched larva differs from the other species in being pale whitish, tawny, or luteous. The body is almost white, including all the legs. The head is pale honey-yellow. The body is a little flattened, with the prothoracic tubercles large and prominent. The hairs are all pale tawny, with no dark ones; those on the sides of the body and at each end very long, some of them rather longer than the body. Otherwise the larva is of the same general shape, and without tufts or pencils or eversible glands, as in the freshly hatched larvæ of the other species of the genus.

#### FAMILY ARCTIIDÆ.

##### The transformations of *HALESIDOTA CARYÆ* Harris.

The latest and fullest description of the different stages is by Miss C. G. Soule in *Psyche* (VI, 158); she states that the larva molted six times. Mr. Dyar gives nine stages (*Psyche*, V, 422).

A batch of eggs received from Mr. H. Meeske hatched June 19th, A. M.; all (over a hundred) hatching nearly simultaneously. The freshly hatched worms devour a part of the empty egg-shell, before beginning to feed. They feed well on the elm, also will eat the leaves of the wild cherry and chestnut. It is a remarkably beautiful and conspicuous caterpillar.

*Egg.*—Diameter 0.8 mm. Hemispherical in shape, the dome rather high; green when first laid. The shell is very thin and glassy, when empty reflecting the colors of the rainbow; the surface is smooth, and under a  $\frac{1}{2}$ -inch objective is seen to be indistinctly pitted

with shallow polygonal areas, with an indistinct very slightly raised edge. The micropyle forms a distinct rosette at the apex of the dome, composed of oval wedge-shaped areas. The larva escapes through a wide elliptical opening, and does not invariably eat up its shell.

*Larva, stage I.*—Length 2.5 mm. Described two or three hours after hatching. The head is very large and black, much wider than the body, which is pale livid flesh-color, with chestnut-brown warts, which are not so dark as the head. The prothoracic shield is large and broad, crescentiform. On the 2d thoracic segment are two double transverse warts, with a minute median wart between. On the 3d thoracic segment the two corresponding warts are less united, the inner ones larger than the outer, and sometimes a faint minute median one is indicated. The four dorsal warts on each abdominal segment are arranged in a trapezoid. Each wart bears a single hair. Suranal plate transversely elliptical. Duration of stage I about ten days (that of Miss Soule's brood about 6 days).

*Stage II.*—Described three or four days after the first molt, length 4 mm. The body is now pale, almost whitish-carneous, the head and warts strongly contrasting with the hue of the body. Usually but one, and no more than two hairs arise from the warts, and the hairs on the thoracic and last abdominal segments are longer than those in the middle of the body. The head is black and the prothoracic shield and warts are blackish-brown.

Towards the end of the stage (July 2) the larvæ are still gregarious. Length 6 mm. The head is now black, not so wide as the body, which is pale whitish as before, with black tubercles and whitish tubercles, a few longer hairs at each end of the body; they are sparse, with a few black ones intermingled. The warts are all black, with only from 1 to 3 hairs arising from each one. Duration of stage II about 10 days (duration stated by Miss Soule about 7 days).

*Stage III.*—Length 10 mm., becoming 13–14 mm. Described July 12th. The body is now thick, tapering at each end, shining pearly-white, with large black tubercles from which arise white hairs, of very unequal length, most of the longest ones equalling the diameter of the body; a few others, one from the side of each segment, being twice as long as any of the others. On 2d thoracic segment is a slender lateral black pencil of hairs, not so long as the body is thick, containing a single black hair which is twice as long

as the others. On each abdominal segment (1-8) is a pair of dorsal short, slender black pencils crossing each other, and arising from the forward pair of tubercles; there being none on the thoracic segments. All the legs, thoracic and abdominal, are black. As late as July 18th many were molting into this stage, having spun a carpet of silk on which to rest, and in which to fix their crochets during the process of exuviation.

*Stage IV.*—Length 18-20 mm. The body is now much larger and thicker than before, but the arrangement of the hairs and their color are as before, and the tubercles are of the same dark tint.

*Full-fed larva, stage V.*—Described September 25th. Length 35-38 mm. The head is entirely jet-black. The body is of a delicate pale bluish-white, with the sutures in front broadly painted with black, with irregular black spots and lines between the tubercles, which are also black. The body is entirely concealed from above by the very dense hairs, while on the sides the verticils are not so dense and the body appears through them. On the back the hairs are dense and evenly trimmed, while on the sides they are quite uneven. The hairs are in general snow-white, those on the sides spreading out widely, as in the other species. On the 1st abdominal segment is a pair of high, slender, lateral black pencils; and another pair slightly shorter on the 7th segment. Along the back is a series of 8 double wedge-shaped black median dorsal tufts, on each side of which and between which on each side is a subdorsal row of transverse linear black marks, forming the center of transversely elongated tubercles, the hairs radiating obliquely so as to leave the top of the tubercles exposed. On the sides is a series of round black tubercles, with several irregular black spots scattered below; still below which is a series of smaller lateral black tubercles giving rise to white hairs. A few black hairs on top of the thoracic segments and more dorsal black ones arise from the end of the body, some of them forming two slight pencils, each consisting of about 9 or 10 black uneven hairs.

#### The life-history of *HALESIDOTA MACULATA* (Harris).

I found the young larvæ from stage II to the full-grown larvæ feeding on poplar at Brunswick, Maine. Those in stage II occurred on the under side of the leaf, August 5-7.

*Stage II.*—Length 7 mm. The head is black, nearly as wide as the body, which is straw-yellow, with a black prothoracic shield,



which is moderately large, rounded on the sides in front, but angular on each side behind. The rather large tubercles in general bear from one dozen to two dozen spinose hairs. On the 1st abdominal segment is a large conspicuous transverse oval black spot, bearing a piliferous tubercle from which an irregular tuft of black hairs arises, and another on each side of the same segment also sending off a tuft of black hairs. On the 7th segment is a similar large conspicuous black swollen double wart. There is a large double dorsal black wart on the 8th segment from which arises a double black tuft. There are five black lunate warts on the side of abdominal segments 2-7, and on each of these segments are four dark greenish dorsal warts arranged in a trapezoid. *The dorsal black tufts present in the next stage are not yet indicated*, as the hairs in general are pale yellowish. The larva in this stage is a very conspicuous object, but yet very different from the full-fed larva. The thoracic and abdominal legs are blackish, the four pairs of middle abdominal legs paler.

*Stage III.*—August 10th to 18th. Length 13 mm. The characters of the full-grown larva are attained in this stage. The head is black, as wide as the body, *which is now entirely concealed by the hairs*, the latter arranged in dense bunches and of unequal length. A few long white hairs arise from the 1st to 3d thoracic segments; the other hairs are straw-yellow, except *a row of eight double median dorsal black tufts*, the first and last ones much larger than the others. There is a pair of lateral thick black pencils on the 1st and 8th abdominal segments. The tubercles giving rise to these pencils are surrounded by black, and there is a broad black lateral broken band connecting the black patches on the 1st and 8th abdominal segments; elsewhere the skin is pale. (In one specimen the broad lateral black band is wanting.) The generic characters appear in this stage.

*Final stage.*—September 3d, Maine. Length, when at rest, 25 mm. Body blackish, densely covered with deep lemon-yellow hairs so that it cannot be seen when the larva is at rest; they are longer on the sides than on the back, so that, as in the other species of the genus, the larva appears a little broader than high. Head black, clypeus and antennæ whitish; the head in general is provided with sparse unequal black hairs. The hairs on the thoracic segments are all lemon-yellow above, and low down on the sides they are also usually yellow, though sometimes black, according to

Saunders. On abdominal segments 1 to 8 is a row of eight double dorsal black tufts, appearing as if single wedge-shaped tufts; the first tuft is higher and narrower than the others; the 7th one much shorter and wider, the others in front gradually becoming more like it in shape, going backwards. A pair of lateral black tufts on the 1st and 7th abdominal segments, projecting slightly beyond the yellow hairs; the hinder pair is a little thicker than the front pair. From the thoracic segments arise about six slender long white pencils composed of few hairs which are nearly as long as the body is thick, and of uneven length. On the 8th and 9th segments are (in all) three pairs of similar pale, whitish, very slender tufts. The abdominal feet are pale livid; the thoracic feet are black.

For the sixth and seventh (last) stages, with a description of the cocoon and pupa, see Dyar (*Psyche*, VI, 165).

#### Life-history of *HALISIDOTA TESSELLATA* (Abbot and Smith).

The following notes were made while watching the development of a brood found feeding socially on the under side of a white ash leaflet at Brunswick, Maine, August 12th. The brood had evidently all undergone their first molt. When disturbed they fell off and let themselves down by a thread. (Since these notes were prepared Mr. H. G. Dyar has published in *Psyche*, VI, 164, descriptions of all the stages (nine) of this larva; but without giving measurement of the length of the larva, though careful measurements of the head are given.)

*Stage II.*—Length 6 mm. The body is rather broad and flattened, slightly decreasing in width to the end. The head is shining black, nearly as wide as the body. The body is greenish-yellow, with a livid hue; it is yellow on the three thoracic segments, and on the 8th abdominal. The piliferous warts are large, black, conspicuous, giving rise to sparse radiating bunches of grayish-white hairs of unequal length. Some of the dorsal hairs are blackish, and of these about half a dozen arising from the thoracic segments, and two from the 8th abdominal segments are about half as long as the body, the longest ones, however, occurring on the thoracic region of the body.

*Stage III.*—Length 12 to 15 mm. (Described soon after exuviation.) Now the generic characters are assumed. The head is entirely black, except the front of the clypeus, the lobes of the labrum, and the basal joint of the antennæ, which are white. The

body is in general black, honey-yellow on the sides, including the abdominal legs. The dorsal warts emit short radiating even white hairs; those low down on the sides spreading and much longer and more uneven. From the second thoracic segment long white hairs project over the head, with several black ones on each side. *From the third thoracic segment arise two subdorsal oblique distinct black tufts.* On abdominal segments 7 and 8 is a short conical double black dorsal tuft, that on the 8th segment twice as large as the one on the 7th segment, and from each side of the same segment projects a *black pencil*; among the black hairs composing the pencil is a white hair longer than any of the others. The base of the tubercle, from which the pencil arises, is whitish, and in part deep flesh-colored, and the spiracles of the ninth pair are white and conspicuous.

*The end of stage III just before moulting.*—(Described September 18th.) Length 14–20 mm. Head as before, black with the front part of the clypeus, the labial lobes and the basal joint of the antennæ white. The body is not entirely livid, blackish, there being a broad pale whitish band along the sides of the body between the white spiracles and the base of the legs. Along the back the median dorsal tufts on abdominal segments 1–6 of the two last stages are still wanting, so that the blackish body shows through the hairs. On the 7th abdominal segment is a median dorsal black double wedge-shaped tuft, and on segment 8th there are two double wedge-shaped black tufts, a little longer than in front, and composed of black hairs arising from the four dorsal tubercles of this segment; the outer of these warts have, arising from the side, the short radiating whitish hairs, the pencil of black hairs arising from the inner side, so that from one and the same tubercle originate short radiating whitish hairs, and also long black hairs. From the largest lateral tubercle on the same segment besides about sixteen whitish radiating hairs of unequal size and length, arises a pencil consisting of nine long black hairs. This pencil in the present stage is smaller and shorter than in the last stage, and easily overlooked. The anterior black pencils also arise from warts which also send off the short radiating hairs. The four anterior black pencils are also smaller and slighter, composed of a less number of hairs than in the last stage.

In this stage, also, in larvæ 20 mm. in length, the three thoracic segments are whitish behind on the back, and dusky in front.

*Stage IV.*—Length 24–25 mm. (Described September 18th.) The head as before. The radiating hairs are now whitish-yellow to pale

golden-yellow. The black pencils are now large and well developed, and now *the first six abdominal segments have well-developed dorsal tufts*. This is due to the increase in number and size of the hairs arising from the inner side of the median dorsal tubercles or warts. In the fully fed larva they are still denser, and form the series of median dorsal tufts, eight in all, one to each segment. Compared with the final stage, the body is still visible through the hairs, and the white infraspiracular band is still in part retained, while the radiating hairs are paler, shorter and sparser, and less silky.

*Stage V and last.*<sup>1</sup>—Length 30 mm. (Maine, on willow, September 10th to 15th.) It is of the same size as *H. maculata*,<sup>2</sup> also on the willow in Maine. The head is black, but with the anterior division of the clypeus, together with the basal joint of the antennæ, labral lobes, labium and maxillæ, white with a yellowish tint. The body is black, but beneath pale livid yellowish along the middle. Thoracic legs pale pitchy; abdominal legs pale flesh yellow. Spiracles whitish. The tubercles are black, but the hairs radiating from them are dense, and all uniformly pale golden-yellow, those of the dorsal median wedge-shaped tufts dusky at the end. The last of these tufts is slightly longer than the others. There are two long black pencils arising from the 2d thoracic segment and projecting nearly horizontally in front; a second pair of similar black pencils from the third thoracic segment, the latter giving rise to a pair of lateral whitish pencils. A few long black hairs are mixed with the long white hairs projecting from the prothoracic segment and reaching over the head. Two irregular white pencils, but slightly distinguishable from the other white hairs, project out from behind at the end of the body.

On the thoracic segments between the 1st and 2d pairs of black pencils are, on the 2d and 3d thoracic segments, two pale yellowish-ochre dorsal patches, which only become visible when it is creeping; in fact these two segments are yellowish-ochre above, with blackish patches.

<sup>1</sup> As those raised from the white ash were poorly and irregularly fed, they were much less developed than those feeding wild on the willow, and which reached maturity early in September. The ash caterpillars were only 25 mm. in length, and the yellowish hairs even much paler than in normal larvæ. The median dorsal wedge-shaped tufts in all are dusky at the end, the inner hairs of the tufts being blackish, either the whole hair or the ends only.

<sup>2</sup> In my report on Insects Injurious to Forest and Shade Trees, p. 353, this caterpillar is wrongly referred to as probably *H. maculata*.

*Summary of the more salient ontogenetic features.*

1. But a single hair arises from a tubercle in stage I (Dyar).
2. Several hairs arise from a wart in stage II.
3. The generic features begin to appear in stage III, since from the third thoracic segment arise two subdorsal oblique distinct black tufts; and on the 8th abdominal segment is a black pencil.
4. The abdominal segments 1-6 are provided in stage IV with well-developed dorsal wedge-shaped tufts like those in the last stage.

Note on *H. harrisii* Walsh.<sup>1</sup>

This is the yellow variety of *Halesidota tessellata*, with a honey-yellow head and orange-colored pencils.<sup>2</sup>

*Mature? larva.*—This variety was found at Providence, R. I., September 15, 1890, by the roadside on the carraway. Length 18 mm.

The head is *honey-yellow*, the anterior division of the clypeus, with the labrum and antennæ, whitish. The body is so densely covered with uniformly silky-*white* hairs as to conceal it when at rest. There are no hairs of any other color except the four anterior dorsal pencils, which are of *a rich ochre-orange buff color*; of these the front pair arise from the 2d segment, and the hinder pair from the 3d thoracic segment. There are two shorter lateral pairs of white pencils, one in front arising from the 2d thoracic, and the other from the 3d thoracic segment.

From the 8th abdominal segment a pair of dorsal pencils of white hairs project outward and backward, while a few long hairs project back horizontally from the very end of the body.

There is a pale chitinous broad and short prothoracic shield divided into two halves by a pale line.

The body is whitish, with a lateral row of large black patches situated on each segment near the spiracles when they are present; the latter are ringed with black, and lower down is a row of large irregular black patches at the base of the legs. The thoracic and

<sup>1</sup> For interesting remarks and descriptions of the *seven* stages of this form see Dyar (Psyche, VI, 162); in this paper Mr. Dyar regards *H. harrisii* as a distinct species from *H. tessellaris* of Abbot and Smith, as the larvæ differ in their first as well as later stages, and he finds differences in the male genitalia.

<sup>2</sup> Proc. Bost. Soc. Nat. Hist., IX, 1864. Walsh does not mention the color of the head in either of his two forms of *tessellata*.

abdominal legs are all pale whitish, like the body. All the setiferous tubercles are white like the body.

This larva is entirely unlike the 4th stage of normal *H. tessellaris* (Abbot and Smith).

The egg and mature larva of *EUCHETES COLLARIS* Fitch.

The larva (♀) occurred at Brunswick, Me., on the dogbane (*Apocynum androsæmifolium*), August 16th. On the 25th it spun a cocoon.

August 29th the pupa was still whitish. The moth appeared in the breeding-box on May 27th succeeding. For some eggs I am indebted to Mr. H. Meeske.

*Egg*.—Diameter 0.7 mm. Of the usual hemispherical shape, the dome moderately high, and at the apex slightly raised. The shell is thin, glassy, and perfectly smooth under a  $\frac{1}{2}$ -inch objective, with no traces of pits or polygonal areas.

*Freshly-hatched larva*.—(Described from several alcoholic specimens.) Length 2 mm. Head scarcely wider than the body, pale whitish flesh-colored; the eyes situated on a dusky patch; with a few scattered dusky hairs. The body is cylindrical, whitish, with pale umber-brown piliferous warts. Prothoracic shield rather large and broad, with a pale median suture, partly dividing it into two parts; each half bearing two piliferous warts in front, and three behind. The 2d and 3d thoracic segments with suboval dorsal warts each bearing two unequal black hairs, the longest ones nearly twice as long as the body is thick. The subdorsal and lateral warts each bear a shorter single white spinulated hair. Along all the abdominal segments are two additional small hemispherical approximate dorsal warts, each bearing a single dark hair; these, in addition to the dorsal two-hair-bearing tubercles of the 2d and 3d thoracic segments. On each side of these abdominal segments not bearing legs, are two piliferous warts below the lateral ones. All the abdominal legs have a longitudinal large dusky patch on the outside, which is also present on the anal legs. The longest hair arises from the 1st abdominal segment, and these two are twice as long as the body is thick. All the hairs are spinulated as usual in the family. The abdominal legs each bear but four ungues.

*Full-fed larva*.—Length 22 mm. The body is cylindrical, rather thick, pale whitish, and completely concealed by beautiful long silky woolly slate-gray hairs; the longer hairs being considerably

longer than the body is thick; the shortest ones are of the same color as the longest. The spiracles are pale, surrounded with a narrow black ring. The piliferous tubercles are pale, but mostly speckled with dark at the origin of the hairs.

The larval stages of *LEUCARCTIA ACRÆA* (Drury).

It feeds voraciously on plantain leaves, and makes a great quantity of frass. The eggs were laid June 19th, at Brunswick, Me., the larvæ hatching June 25th, in the morning, their first act, after breaking out, being to devour the shell.

*Egg*.—Diameter 0.6–7 mm. Hemispherical, rather high, white, with a coarsely pitted surface as seen under a triplet; under a  $\frac{1}{2}$ -inch objective the deep pits are seen to be closely crowded, and surrounded with smooth swollen polygonal edges; the pit itself being rounded. The larva eats away the upper half of the shell, the edge being scalloped, each scallop representing the cut made by the jaws.

*Larva, stage I*.—Length slightly over 2 mm. The body is pale or somewhat dusky flesh-colored, without any reddish tint. The head is shining black, large, wider than the body. The prothoracic shield is well-developed, crescent-shaped, contracted in the middle, the surface on each side gibbous; dark chestnut. The piliferous warts are rather large and quite convex. The two dorsal tubercles of 2d and 3d thoracic segments bear two hairs, the lateral ones bearing each two hairs. The abdominal dorsal tubercles all bear but a single long spinulated hair, except the lateral ones, which bear two small short hairs of unequal length; all the subdorsal warts bear but a single hair. Some of the hairs are nearly as long as the body. The double dorsal row of small warts are rather peculiar. The thoracic legs are chestnut, the abdominal ones of a dusky flesh color. There are 2 sets of ungues on each abdominal leg.

It moulted June 30th to July 2d, the duration of the stage being about 5 or 6 days.

*Stage II*.—Length 5 mm. The head is, after it has fed a few days, narrower than the body, chestnut-black; the clypeal and labral region pale flesh. The body is pale greenish, with yellowish tints. The prothoracic plate is now divided into halves. The tubercles are dark, the hairs blackish. The dorsal and subdorsal warts bear usually five hairs, one very long, the four others shorter

and smaller, varying in size; the longest ones are three times as long as the shorter ones; the lateral warts still bear but two hairs. There is a subdorsal row of reddish-brown irregular spots, and another similar row on the sides low down. The thoracic and abdominal legs are blackish.

It molted July 10th to 12th; the duration of the stage being about 10 days; and was described after molting on the 12th of July.

*Stage III.*—Length 15 mm., finally becoming 20 mm. The head is small, black; the body thick, tapering at each end. All the tubercles are black, with black and white hairs of unequal length, the longest equalling the diameter of the body. A broad, somewhat broken white, conspicuous dorsal line finally becoming yellow. An interrupted yellowish broad band on the side, bounded above and below by a whitish-yellowish line somewhat wavy, and interrupted by the yellow patch on each segment forming the broken band; the tubercles being situated in the yellow patches, one in each; they are black at each end of the body, but yellowish or nearly so in the middle segments. All the legs are blackish.

Molted July 20th to 25th; the length of this stage being about 10 days.

*Stage IV.*—Length 35 mm. Much as before, but much larger, the pale yellowish dorsal line is now wanting and the entire dorsal region has become dark leaden-gray, with short spreading verticillate hairs on the two middle rows of tubercles, the subdorsal ones giving out longer unequal hairs, which are more or less leaden-gray. There are now two parallel lateral rows of small bright yellow spots; between each set of spots are two light reddish-brown tubercles which give off gray hairs, mixed with whitish ones. The hairs cover the body more densely than before; and the head is black and the body beneath deep leaden-gray. All the feet, both thoracic and abdominal, are black. The spiracles are whitish on a blackish field. The head with the clypeus above and the antennæ are yellowish, but the yellow spot on the clypeus is smaller by one-half than in stage III.

It molted again July 30th to 31st, hence the length of stage IV was about 10 days.

*Stage V and last.*—Length 35 to 40 mm. A great change takes place at this molt. Now the hairs are long and slender, fine and soft, and most of them as long as the body is thick, with a few at



each end of the body twice as long as the others, the long ones more numerous at the end than on the thoracic segments. The dorsal hairs are sable-brown-black, so thick that the outlines of the body can be scarcely seen through them; the warts are also dark, though the lateral warts are still reddish-tawny. From the lower side of the supra-spiracular tubercles arise hairs which are all reddish-tawny; those arising from the upper edge are reddish at base, and blackish on the end, or remainder of the hair. The lateral hairs are bright tawny. The light buff-colored spiracles are now very conspicuous, and are situated directly in front of the large tubercles.

*Note.* There is a tendency in this and other Arctians to become, after the 2d molt, much more hairy, so as nearly to conceal the body, and thus, as by this time they feed in more conspicuous situations, they are less edible to birds and less exposed to attacks by ichneumons and Tachinæ.

This is now a very handsome caterpillar, the close dorsal hairs, like the fur of the sable in general appearance, contrasting with the bright tawny hairs on the sides, the bright conspicuous spiracles showing through them.

Life-history of PYRRHARCTIA ISABELLA (Abbot and Smith).

Dyar remarks that this larva has ten stages, *Psyche*, V, 422.

The eggs of this moth were received from Mr. H. Meeske, of Brooklyn, N. Y., and were laid in confinement May 12th. The larvæ were active, feeding on the wild cherry; after hatching they scatter, and eat away the surface of the under side of the leaf, not eating holes in the leaves. Another set of eggs, laid in a small patch, was found on the under side of an oak leaf at Brunswick, Maine, July 6th, hatching a day or two later.

*Egg.*—Diameter 0.7 mm. Hemispherical, but the dome is quite high and regularly rounded, white, smooth and shining, and smooth seen under a Tolles triplet, but under a Tolles  $\frac{1}{2}$  inch-objective the shell is seen to be marked with a network of very fine, minute, quite irregular polygonal areas, bounded by very slightly thickened edges, as if they were the imprint of the cellular walls of the oviduct.

*Larva, stage I.*—Length 2.5 mm. Hatched June 14th. Head dark chestnut, moderately large, no wider than the body. Prothoracic shield moderately large, irregular in shape, with a transverse furrow behind the middle; on the front arise four hairs, and on the

hind edge are two hairs. The 2d and 3d thoracic segments bear each a transverse row of four flattened dark brown conical tubercles; the two inner and larger of which bear two hairs. All the abdominal tubercles bear but a single hair.

The median dorsal tubercles (two on each segment and wanting as usual on the thoracic segments) are elongated, while the outer ones are irregularly rounded; the lateral tubercles are rather narrow and elongated parallel with the length of the body. The hairs are long and spinulate. A few hairs are longer than usual; these arise from the 2d and 3d thoracic and also the 8th abdominal segments, and are about a third as long as the body.

*Stage II.*—Length 4–5 mm. Described about one day after the first molt. The head is as wide as the body and of a dark chestnut-brown. The prothoracic shield is distinct, crescent-shaped. All the warts are concolorous in hue, moderately dark chestnut, and most of them bear 5–6 hairs. The dorsal thoracic hairs are about twice as long as the body is thick, as also are those on the 8th abdominal segment, but the others are rather shorter, and all the hairs are uniformly of the same rather dark brown color, of the same hue as the head. There are about 10 spinulose hairs arising from the larger dorsal tubercles. The body is livid purplish all over, the piliferous warts are now higher and fuller, but are chestnut-colored, with a slight ruddy or purplish tint. The body is fuller and thicker than before, while the hairs are somewhat shorter, and all are of the same dark-brown color. The small median dorsal tubercles bear 2 to 3 hairs, and the larger ones from 10 to 12 hairs.

When 5 mm. long, later on in this stage, the body is purplish pale flesh-colored; the warts purplish and quite convex, the hairs all dark and longest on the 2d and 3d thoracic segments, those on the other segments only a little longer than the body is thick. The body beneath is paler.

One about to molt is 7 mm. long. The body is mottled with short irregular purplish lines, and there is an irregular lateral broken pale narrow line. The warts are black at the end, and there is no difference in the color of the hairs on any part of the body, all of them being nearly black, with no reddish ones.

*Stage III.*—Molted June 29th, and described before beginning to eat on that date. Length 7 mm. The body is now stouter, and the hairs on the three thoracic and 1st abdominal segments, also on segments 7 to 10, are black-brown as before, while those on the

middle of the body (abdominal segments 2 to 7) are much paler, being of a brown flesh-color, though with no reddish tint; among the pale flesh-brown hairs are a few scattered black lateral and dorsal ones. The tubercles are large, bearing numerous hairs. The head is uniformly of a pale horn color.

On June 30th, the colors of the black and of the tawny-brown hairs are now respectively more pronounced and dissimilar, so that we have indicated the differences in color between the reddish abdominal segments 2-7 and the bluish hairs of the rest of the body, characteristic of the mature larva. A dorsal pale indistinct stripe is present.

*Stage IV.*—Length 15 mm. A specimen bred from the oak is now almost exactly like the adult. The head is dark chestnut, and the five succeeding segments are black; the tubercles and hairs of the hinder edge of the 2d abdominal, and the whole of the three succeeding segments (3-6) scotch-snuff reddish-brown or tawny, exactly as in the full-fed larva, while the 8th to 10th segments are black with black hairs and tubercles. On the 2d thoracic segment are a few reddish hairs. A few hairs in front and on the hinder end are nearly or quite twice as long as the others, which in general are about two-thirds as long as the body. The thoracic feet are black; the abdominal feet dark, with the plantæ flesh-colored. This caterpillar remained alive and without molting till the 8th of September. I saw several full-grown larvæ September 8th.

It appears from the above-stated facts that the characters of the mature larvæ, *i. e.*, the dense hairs, those on the 3d-6th abdominal segments being reddish, are indicated in stage III, and completely appear in stage IV.

The freshly-hatched larva of *SPILOSOMA VIRGINICA* (Fabr.).

Eggs laid May 20th and hatched June 2d to 4th; mostly dead, but one or two hatching June 5th.

*Larva just hatched.* Length 2 mm. Body pale greenish; head large, slightly wider than the body, dark chestnut-brown; the two sides full and swollen, with a pale suture between. All the piliferous warts dark chestnut, conical, very distinct, contrasting with the pale greenish body. Hairs blackish, very long, some of them over one-half as long as the body. A faint crescent-shaped prothoracic

shield bearing two transverse rows of piliferous warts. No middle dorsal small twin warts on the thoracic segments.<sup>1</sup>

A very dark almost black Arctian was found crawling in the city of Providence September 26th, from which I reared a moth of this species. I describe the larva as follows:—

*Full-grown larva.*—Length 35–38 mm. Body dull smoky black, with white spiracles. The hairs all black, except a dark reddish tan-brown shade on the abdominal segments. The head is rather small, black, the clypeus, antennæ, and labrum, as well as mouth-parts, pale greenish. The body is of the same general shape as that of *P. isabella*, but the hairs are not so stiff or dense. The body is black, as are also the tubercles. The verticils are dense, composed of hairs of uneven length, those on the back (dorsal and subdorsal) of abdominal segments 3 to 7 are mostly dark reddish chestnut-brown, almost blackish, mixed with black ones, but the lateral tubercles all send off black hairs. Besides these there are a few very long hairs, which are grayish at the end, and these are a little more numerous at both ends of the body, a few more arising from the last three abdominal segments than from the three thoracic segments. Suranal plate and sides of all the black abdominal legs speckled with white granules like fine white sand (it does not brush off, and can't be sand!) Under side of the body dark livid smoky black. The thoracic legs are pitchy black, pale at the tip. A very richly colored velvety-black, handsome caterpillar.

The cocoon is unusually dark, being blackish-brown, while the moth, a male, had the black spot on the under side of the base of the forelegs unusually large; otherwise it does not differ from typical specimens.

*A foxy-red larva of Spilosoma virginica (Fabr.).*—Head, including the mouth-parts, amber. The body is livid black. No pale lateral band is visible, but the sides of the body, including the spiracles, are paler than above, and especially beneath. The spiracles are white. All the hairs are foxy reddish-brown, except those

<sup>1</sup> Mr. Bridgham's drawing of *S. virginica*, stage I, does not very well represent my larva, as in mine the head is wider than the body, dark chestnut, and not as he represents it pale, with two darker spots. The warts are also darker. The color of the body is good. The shape of the prothoracic shield differs, as in my larva it is crescentiform, not transversely oblong. Yet his drawing is not that of *H. cunea* or *A. virgo*!! I am, of course, sure my moth is *virginica* and not *cunea*.

of the prothoracic segment, and the sides, low down, of the 2d and 3d thoracic segments. Most of the hairs, especially along the back, are not quite so long as the body is thick; some are very long, as described in the yellow variety, and the lateral ones are less evenly cut and longer than the dorsal verticils. A few black hairs are mixed with the reddish ones along the sides. The tubercles are not foxy-red like the hairs. The thoracic legs are pale amber, while the abdominal ones are black, with pale plantæ.

The two last larval stages of *SEIRARCTIA ECHO* (Abbot and Smith).

The following descriptions have been drawn up from specimens from Punta Gorda, Fla., collected in March, 1891, and presented by Mrs. Slosson. They will feed on almost any kind of leaves. As my descriptions in *Psyche* (V, 351) were drawn up from colored figures, the following notes may take the place of my descriptions of the two last stages.

*Larva, stage V?*—Length 12 mm. The head is fully as wide as the body, ochre-yellow, concolorous with the setiferous tubercles, which are large, high, and prominent, bearing bristles as long, some longer than the body; they are black-brown, becoming ochreous at the base, while in front and at the end of the body there are a number of gray bristles. On each abdominal segment the two median dorsal small tubercles are crowded in front of the two much larger lateral ones. The segments are transversely banded with two parallel rows of cream-white irregular linear slashes, three in each row, varying somewhat in shape and in distance apart. The prothoracic segment is ochreous-yellow like the head. The body is dark black-brown, contrasting with the reddish-ochreous tubercles. (This does not entirely agree with Mr. Bridgham's figure of the 5th stage, as the head is *all* ochreous.)

*Full-fed larva.*—Length 30 mm. Head cherry-red all over; anterior division of the clypeus and the antennæ whitish. Tubercles reddish-ochreous; the hairs mostly reddish-ochreous at base and black on the outer half. Body dark Vandyke-brown. Prothoracic segment like the head, but of a duller hue. 2d thoracic segment with a pale cream-white spot in the middle, and a transverse whitish slash on each side, while behind is a faint cream-white broken transverse line; on the 3d thoracic segment are two transverse cream-white lines, and between them, but nearer the hinder

line, is a median and two lateral cream-white spots. Each abdominal segment with two similar transverse lines, without the intermediate spots; in the anterior line is a dilatation in the middle. In the hinder abdominal segments the hinder of the two cross-lines may be obsolete or represented by a median and a lateral spot. (It agrees very well in general appearance with Bridgham's drawing of the sixth stage, also in the position and color of the tubercles and of the markings, allowing for variation in the latter.

*Egg*.—Diameter 0.9 mm. Hemispherical in shape, rather high. The empty shell is thin, glassy, and seen under a triplet to be rather coarsely pitted; under a  $\frac{1}{2}$ -inch objective the pits are deep, of uneven size, round, but bordered with a raised swollen irregularly polygonal margin. The egg is much like that of *Leucarctia acræa* in shape and ornamentation, the pits being very similar.

The fully-grown larva of *ECPANTHERIA SCRIBONIA* (Stoll).

I found a larva on the alligator pear (?) growing on Mr. McCormick's grounds at Lake Worth, March, 1891. It will feed on geranium, and will eat almost anything except orange leaves. Very hardy, standing transportation to the North well.

Length 60 mm. The head is black, becoming cherry-red on the sides and along the front at the base of the labrum. Body deep velvety-black, and with dense fascicles of long dense barbed brown-black hairs.

When the caterpillar is in motion the sutures on opening are seen to be stained with Indian red or brown madder, forming a conspicuous stripe.

All the eight stages of this species, raised from Florida, have been described at length by Mr. Dyar in the *Canadian Entomologist*, XXIII, 106.

The full-fed larva of *ECPANTHERIA PERMACULATA* (Pack.).

I received two larvæ, from one of which this moth was reared, from Mr. Th. D. A. Cockerell, of West Cliff, Colorado. He wrote me under date of April 28, 1890, that the caterpillars were collected near Grape Creek, West Cliff, April 28, 1890, and he sent me the brief description, from life, given below. Mr. Cockerell was unacquainted with the food-plant.

The caterpillar began to pupate between May 9th and 15th, spinning a slight cocoon between the leaves offered the larva (which, however, took no food). The imago appeared about a month later, viz., June 19th.

*Mature larva.*—"Length about 30 mm. Head shining black; body purplish-gray; each segment with dark tubercles (twelve on most of them), each emitting a bunch of shortish spinulated hairs. These hairs are of two colors, the anterior part of the bunch being black, and the posterior pale shining ochreous. Legs reddish-ochreous." (Cockerell.)

The partial life-history of *UTETHEISA BELLA* (Linn.).

The eggs and freshly-hatched larvæ were kindly sent me by Miss Caroline G. Soule. The food-plant was *Myrica gale*. The eggs are laid in confinement, either singly or in patches. The young larva was described August 1st.

*Egg.*—About half a millimeter in diameter. When alive it appeared on the leaf to be hemispherical, though rather high, but the alcoholic specimen is certainly spherical. Under a Tolles triplet magnifying 10–12 diameters, the living egg is seen to be smooth, shining, with no pits or granulations. The color was not noted; but the alcoholic one is yellowish. Under a  $\frac{1}{2}$ -inch Tolles objective the shell also appears to be smooth, with no granulations visible.

*Larva, stage I.*—Length 2 mm. Head large, considerably wider than the body; dark chestnut-brown, being of the same color as the piliferous tubercles. The body is pale greenish with a yellowish tinge. It slightly narrows from behind the head to the end. The prothoracic plate is rather large, bearing four setæ on the front edge, and four others on the hind edge. The dorsal tubercles on the 2d and 3d thoracic segments each bear two hairs, the lateral warts each bearing one. The dorsal abdominal tubercles on segments 1 to 7 each bear a single hair, though the largest lateral one on the 3th segment bears 3 hairs, and the dorsal ones each 2 hairs. The dorsal abdominal tubercles are arranged in a trapezoid, the two in front nearest the median line are larger than those behind, instead of being much smaller, as in typical Arctians, such as *Spilosoma*, *Leucaretia*, etc., moreover the trapezoid forms a moderate curve rather than an exact trapezoid. Under a  $\frac{1}{2}$ -inch Tolles objective the hairs are seen to be very minutely spinulose and tapering; they

are all dark brown, and their average length is a little longer than the body is thick. The plantæ in the alcoholic specimens are borne on a very long stalk. Each planta bears four hooks.

For the full-grown larvæ I am indebted to Mr. Otto Seifert, who sent me several which he collected in New Jersey early in October.

*Last stage.*—Length 23 mm. The body is cylindrical. The head is rather small, being about one-half as wide as the body in its middle; it is pitch-red, or reddish-chestnut, smooth, and shining. The body tapers towards each end, and is armed with moderately large, acutely conical though not very noticeable tubercles, each of which gives rise to a single long, thick spinulated hair, the four (on each segment) dorsal tubercles each bearing a black hair; those on the sides of the body bearing shorter, smaller white hairs. The body is beautifully variegated with black, yellow, and white. The segments are black above, with two transverse rows of cream-white angular spots, the sutures broadly marked with buff-yellow. A lateral broken, irregular broad cream-white line. The abdominal legs are buff-yellow, with a dusky patch on the outer side. The thoracic legs are entirely black. The body beneath is buff-yellow.

#### The life-history of *CTENUCHA VIRGINICA* (Charp.).

In the Proceedings of the Essex Institute<sup>1</sup> I described the transformations of this moth, including the two later stages, which I supposed to be the fourth and fifth. During the summer of 1890 I was able to complete the life-history of this interesting form, and the following notes may be added to those already published. The 6th and last stage was described in my first paper.

The males appear to be more common than the females, and were abundant on the shores of Casco Bay, Maine, at Merepoint, Brunswick; but about three miles from where they were observed in 1862. In 1863 a larva in the fourth stage was observed as early as May 16th, while June 6th of the previous year, larvæ both in the fourth and last stages of growth were observed, a few mature caterpillars crawling restlessly about. June 13th the larva began to construct its cocoon, and it pupated four days later, and after remaining in the pupa state nearly a month, the moth emerged July 15th. The eggs were laid in a patch side by side, as in the case of Arctians. The young hatched July 28th, so that the egg state lasted a little less than two

<sup>1</sup> Vol. IV, No. 1, Notes on the Family Zygænidæ, April, 1864.



weeks. In 1890 a larva in stage IV was observed feeding on grass June 22d, and two days later a full-fed caterpillar was found; they were observed more frequently a week or two later, but the last fully-fed caterpillar was seen July 27th. The first appearance of the moths in 1890 was July 13th, when three males entered the window in the night attracted by the light, and males appeared sooner and were afterwards much more numerous than the females. Confining a number of both sexes eggs were laid July 27th to 28th, and these hatched August 8th to 10th, so that the duration of the egg or embryo state is between ten or eleven days and two weeks.

*Egg*.—Length 0.8 mm. or a little less than a millimeter. The egg is regularly hemispherical in shape (not spherical, as stated in 1864), slightly higher than broad. Under a Tolles triplet of high power the shell is seen to be very finely, minutely pitted, but under a low power appears to be smooth and shining. Under a Tolles  $\frac{1}{8}$ -inch objective the surface of the shell is seen to be divided into very minute quite regular polygonal areas, bounded by a slight ridge; from this ridge on one side of the area project horizontally across the middle of the area one, or more usually two very delicate slender tapering hair-like processes nearly reaching the opposite side of the polygon.

The eggs are deep yellow when laid, remaining so till the embryo forms, when they are dark ash-colored, darkest above.

*Larva, stage I*.—Hatched August 8th to 10th. Length 2.5 mm. Head black, smooth, shining, and rather broader than the body. The body tapers slightly to the end; it is at first light yellowish, afterwards becoming darker. In the older, darker ones the body is pale flesh-color, as usual in Arctians. The prothoracic shield is moderately large, being antero-posteriorly quite short, but rather broad, sublunoid; it bears on its front edge four piliferous warts, all of nearly the same size, and each bearing a single hair, which is fine, tapering, like those on all the rest of the body, there being apparently in the Zygænidæ, as in the Arctians, no bulbous glandular hairs. There are no piliferous warts or hairs on the hinder edge of the shield. On each of the two other thoracic segments there are but two large dorsal flattened piliferous warts, which are oval, each bearing three long black hairs, the longest being about twice as long as the body is thick.

Abdominal segments 1 to 8, with four dorsal flattened piliferous warts, each bearing a single hair, arranged in an obscurely marked

trapezoidal manner. The two median ones are hemispherical, situated on each side of the median line, the opposing sides being straight and parallel. There are four lateral warts; the upper one much larger than the others; the 2d minute, situated behind and below the uppermost; the 3d and 4th are narrow and long, the 3d being situated directly beneath the 1st.

On the 9th abdominal segment the four piliferous warts of the other segments are coalesced into two large flattened warts, each bearing three setæ. On the 10th and last segment is a large dark suranal plate with irregular edges, bearing on each side 3 to 4 hairs. All the warts are dark horn-color, and most of the hairs arising from them are dark, some almost blackish, and about half as long as the body.

*Stage II.*—Molted August 18th to 20th. Length 5 mm., becoming August 25th 7 mm. in length. The head is black, rounded, not so wide as the body. The prothoracic shield as in stage I. The 2d and 3d thoracic segments each with two large widely separate dorsal black warts, bearing about 14 hairs of unequal length, both white and black, the longest of which are about one-quarter as long as the body. On each side are two lateral tubercles, slightly larger than the homologous ones on the abdominal segments, these, especially the upper one, on the 2d thoracic segment being larger than the corresponding one on the 3d thoracic segment.

On the abdominal segments (uromeres) are four dorsal piliferous tubercles arranged in a trapezoid, of which the two middle ones are sublunate, the others round; the former bear 2-3-4 short fine hairs; the round ones from four to five longer and thicker hairs.

The body is chestnut-brown, but the warts are surrounded by pale carneous spaces; and the hairs above dark brown, becoming gray on the sides. There is a broad irregular brown dorsal band, and a broad irregular lateral chestnut-brown band, below and above which the body is pale whitish flesh-color, the flesh-colored lines afterwards forming the two lines so distinct in the next stage. The lower of these pale bands become towards the end of the stage a distinct, lateral white line, broken at the sutures; it surrounds the base of the third lateral tubercle, while the fourth and lowest tubercle is surrounded at base with an irregular whitish ring. This infra-spiracular line remains white throughout this stage.

The thoracic legs are chestnut-brown; the abdominal legs pale chestnut, the plantæ still paler.

*Stage III.*—Length 10 mm. Molted August 30th to September 1st. The characters of stage IV are now indicated. The head, however, is still shining entirely jet-black, and is rather narrower than the body. The body is black, with a subdorsal stripe at first white and afterwards becoming yellow as the larva becomes older and larger; also an infraspiracular lateral wavy white longitudinal stripe, the latter the most sharp and distinct, and containing on each segment a black piliferous wart.

From the tubercles on the 2d thoracic segment long white and black hairs overarch the head; similar tubercles and hairs, but shorter, arise from the 3d thoracic segment. The dorsal tubercles are black, arranged in a trapezoid, and from each arises a verticil of 15–16 straw-yellow hairs varying in length. The verticils on the sides of the body are black, with shorter white ones intermixed.

On the first abdominal segment are *two twin dorsal black pencils* appearing as if one; they stand up straight, and are about as long as the body is thick. There are none on the succeeding segments until the 8th, which bears a black pencil not quite so thick as the anterior one, and more irregular, and directed backward. The thoracic and abdominal legs are black, the plantæ pale.

*Stage IV.*—Molted September 5th, and described the next morning. Length, directly after molting, 10 mm., afterwards reaching a length of 15 mm. Just after exuviation and when 10 mm. long, *the row of seven median dorsal double arched black tufts have appeared*, these being undeveloped in the previous stage. The body also is thicker, though at first little longer, and the verticils of hairs are longer, and the hairs themselves much more numerous and dense, so that the body and subdorsal stripes cannot be seen through them, though it can easily be in the third stage. The long dorsal hairs in front and at the end of the body are black; those on each side of the seven black median tufts straw-yellow, while the ground-color of the sides of the body, and the hairs low down, are black. *The head is black.* The lateral or infraspiracular line is now white. A part of the overarching prothoracic hairs are white. All the legs are dark, the abdominal ones livid at the end and on the plantæ.

Not having carefully observed and noted all the transformations of an individual larva, I had supposed that there were only five stages, but while writing out these notes, one larva brought with me from Maine to Providence, and which was in the stage just

described, having an entirely black head and measuring 15 mm. in length, molted September 29th, and assumed a red head; and hence, as I am sure my first three stages are as above described, I feel quite confident that there must be five stages before the last, and that the fifth stage, next to be described, is the one in which the insect hibernates. The following description is taken from several specimens observed June 22d and later in the summer of 1890; my living one, just molted, being somewhat dwarfed. At first the head is entirely light chestnut-red, and the abdominal legs are of the same color.

*Stage V.*—Length 18 mm. *The head light chestnut-red*, becoming blackish in front. Body densely hairy, the head and body when not moving completely concealed by the dense stiff hairs, which are of even length. Those overarching the head and those on the sides of the body are coal-black. The verticils on the prothoracic segment and 9th abdominal segments are snow-white, and white hairs are mixed with the black ones on the sides. The dorsal hairs bright sulphur-yellow. There is a series of nine dorsal double median black tufts, the first pair of which are slightly larger and higher than the others, and directed a little forwards, while the last pair are directed obliquely backwards.

A broad, irregular brown, somewhat scalloped white subdorsal line, while the infraspiracular line is decidedly narrower; it is scalloped or wavy and is bright snow-white, besides being much more distinctly seen than the subdorsal one.

In this stage it continues to feed conspicuously on grass, both in June, and the second brood in September, hibernating in this stage. It transforms into the last larval stage as early as June 24th, and in the summer of 1890, which was very favorable to caterpillar life, the full-grown larvæ were observed as late as July 27th.

*Summary of length of the different stages.*—Egg stage 11 to 13 days; larva, 1st stage 10 days; 2d stage 10 to 12 days; 3d stage 5 to 6 days; 4th stage? 23 days; 5th stage from late in September to late in June; prepupal stage 3–4 days; pupal stage 28–30 days. imago stage probably about two or three weeks.

#### *Recapitulation of the more salient larval features.*

1. As in Arctians and Lithosians no glandular hairs in stage I. Body and hairs as in Arctians. A well-developed prothoracic chitinous shield and suranal plate in stage I.

2. Great increase, in stage II, of hairs, the unipiliferous warts transformed to verticillate polypiliferous warts. At end of stage II the infra-spiracular white line appears.

3. Assumption in stage III of Glaucopidian characters. Appearance of the subdorsal white stripe, becoming yellow at the end of the stage. The yellow dorsal and subdorsal hairs appear. Appearance in stage III of the dorsal black tufts on abdominal segments 1 and 8.

4. Appearance in stage IV of black tufts on abdominal segments 2 to 7.

5. The head previously black, becomes red in the penultimate, or 5th, stage.

6. A decided change in coloration from the penultimate to the final stage, the hairs of the latter stage being all yellow, with no black dorsal tufts.

It will be seen that in stages I and II the larva resembles that of the Arctians; it is minute, not easily detected by birds, and feeds on the leaves of plants enjoying on account of its small size and neutral tints a comparative immunity from the attacks of birds and the visits of insects. When the spiny hairs become dense and gaily colored, and the larva a very conspicuous object, feeding as it does on the spears of grass, it is protected from birds and insects by its dense stiff spiny hairs, and like some, if not most, Arctian larvæ it is comparatively free from the attacks of ichneumons and Tachinæ; in fact I have not seen any *Ctenucha* larvæ which have been parasitized.

Whether the moths, which fly not very rapidly in the bright sun and are much exposed to the attacks of birds, are distasteful or not to birds remains to be proved by experiments, which I have been unable to make. They do not give out the strong odor of *Leucarctia* and other Arctian females.

*Hibernation of the larva in the two last stages.*—Like some Arctians, as *Pyrrharctia isabella*; *Ctenucha virginica* and the Rocky Mountain species (probably *Ct. cressonana*), kindly sent me by Mr. Cockerell, wintered over in the larva state, but while *P. isabella* hibernates in the final stage, that of *Ctenucha*, whether near the coast of New England or in the higher elevations of the Rocky Mountains, does not attain the final stage before the winter, as the eggs are not laid before midsummer (those of Arctians are laid early in June), so that the larva does not have time to com-

plete its growth before the autumnal frosts set in at the end of September, and it is thus compelled to winter over, as is the case with some butterfly larvæ, before the last stage. It will be interesting to ascertain whether this is the case with the more southern California species, and those of *Scepsis*.

#### The young larva of *CTENUCHA CRESSONANA* Grote?

In March, 1890, I received from Mr. T. A. D. Cockerell, of Cliff County, Col., a larva which had hibernated. It could not be kept alive. It is evidently a *Ctenucha* in the penultimate (5th) stage, and congeneric with *Ct. virginiana* in its hibernating or penultimate (5th) stage; and as *C. cressonana* is the common species in Colorado, I am disposed to refer it to that species.

When disturbed it lies curled up on its side, the black dorsal tufts projecting like spikes, and the head touching the tail.

Length 18–20 mm. The head is nearly as wide as the body, reddish-yellow, but not so deep red as in *Ct. virginiana*, and without the two diverging black bands in front. The body is not so densely hairy as in the 5th stage of *Ct. virginiana*, but is more as in stage IV of that species. The body is now scarcely concealed by the rather sparse hairs. The body is dark leaden, and the verticils of hairs are also dark. There is a distinct subdorsal yellowish, and a whitish lateral stripe. On the thoracic segments there are rather long hairs, which arch over the head. On each of the abdominal segments 1–8 there is a long double dorsal pencil of black hairs, the first one inclining forwards, and the last one backwards, the others being more or less erect. All the legs, both thoracic and abdominal, are yellowish, the latter distinctly so.

#### The larva of *PHRYGANIDIA CALIFORNICA* Pack.

These larvæ, two living examples (and others dead), were described May 5th, and others June 5th from life, while the colors were still fresh; most of them had pupated. They were sent April 30th by Prof. J. J. Rivers.

*Full-grown larva.*—Length 12–15 mm. The head is a little wider than the body; it is large, full, globose, smooth, with a few long scattered hairs; pale flesh-colored, with an oblong black patch on each side extending upon the black mandibles; labrum pale. The body is cylindrical, of the same width to near the end; the

8th abdominal segment being distinctly humped, while the segments are transversely wrinkled. The body is pale straw-yellow, with three broken reddish dorsal lines, the median one being the broadest and least broken; the space on each side whitish. Two parallel subdorsal distinct reddish lines enclosing a whitish band, connected in front by a transverse dark reddish-black line on top of the prothoracic segment. The upper of the two subdorsal lines dilates or spreads inward a little on the 1st, 3d, and 5th abdominal segments, and bends up angularly on the 8th, connecting with a transverse dark line crossing the hump. A similar one on the 9th abdominal segment. On the middle of the 5th abdominal segment the median line dilates into a large distinct transverse oblong reddish mark. There are two parallel longitudinal stripes on each segment above the legs, the lower broad and firm, the upper slight and broken up into spots. There are four pairs of well-developed middle abdominal legs; the 5th or anal pair being one-third smaller than the others. There are a few moderately long hairs on the back and sides of the body.

One example has black lines and marks on a greenish-yellow ground. This caterpillar is a true *Agaristid* in appearance, the hump being *well marked* and the body naked, as in that group, though not marked with transverse bars, as in *Alypia* and *Eudryas*.

*Larva at close of final stage.*—Length 18–20 mm. Several of the larvæ when older, having been observed June 17th, presented the following characters. Whether they had molted or not I did not observe. The description was drawn up from living examples, just before pupation, nearly a dozen of the lot having pupated. The head is large, rounded, as wide or slightly wider than the body, smooth, with a few hairs, and now the head is deep cherry-red. The body is smooth, of uniform thickness, with a decided, though not very large and prominent hump on the 8th abdominal segment, and with a few hairs, as before. Along the back are four rather wide broken yellow lines, more or less connected laterally; the lines are broken on the anterior slope of the hump, forming two lunate yellow dorsal spots on the 9th abdominal segment, and a single large yellowish spot on the 10th segment in front of the smooth rounded anal plate. Along the under side is a broad median livid yellowish-green band. Both the thoracic and anal legs are blackish; the four middle abdominal legs being reddish-lilac, and rather large

and long. The sides of the body are dark; the body itself in general dark blackish-brown.

In another and fresher specimen there is a bright yellow spiracular line, somewhat broken by the deep transverse wrinkles of the segments, while the entire under side, including the middle abdominal legs, is greenish-yellow.

In my Report on Forest Insects (1890) Fig. 39, by an unfortunate mistake, owing to lack of lettering, I copied Stretch's figure of *Leucarctia acræa* instead of his figure of *Phryganidia*. I am still inclined to follow Stretch in placing this moth in the *Zygænidæ*; though it should be, as Butler claimed, associated with the "*Dioptidæ*." The larva of *Phryganidia* is smooth and humped, and thus very near the *Agaristidæ*, and quite unlike those of the *Zygænidæ*, which are hairy; but the characters of the moth are like those of the *Dioptidæ*, of whose transformations nothing, I believe, is known.

As regards its venation, *Phryganidia* comes very near *Gnophæla vermiculata*; the number of subcostal branches of the fore wing is six (in *Ctenucha* five), but there is an independent vein, not present in *Gnophæla*. The median vein of *Phryganidia* differs in that the 1st and 2d branches arise at some distance from the discal vein.

In the hind wings the venation of *Phryganidia* is nearly identical with that of *Gnophæla*. I see as yet no good reason for placing *Phryganidia* in a separate family, nor for placing the "*Dioptidæ*," as Smith does, between the *Psychidæ* and *Notodontidæ*, as it has no affinities with either group.

#### FAMILY COSSIDÆ.

The freshly-hatched larva of *PRIONOXYSTUS ROBINIÆ* Peck.

The eggs were received from Mr. H. Meeske, and hatched on July 3d.

*Egg*.—Very large, length 2.7; greatest diameter 1.8 mm. Irregularly oval in shape, with the surface more coarsely pitted than in any lepidopterous egg I have examined. The shell is not very thick, but examined with a triplet is seen to be divided into unusually large shallow irregular polygonal areas. Under a  $\frac{1}{2}$ -inch objective the areas are seen to be very irregularly polygonal, often nearly 4-sided and oblong; the areas are somewhat depressed and with raised edges, which, however, like the areas, are smooth, not granulated.



*Stage I.*—Length 8 mm. A very large larva for one in the first stage. The body is much flattened, somewhat Tortricid-like, tapering somewhat towards the end. The head is broad, flattened, dark chestnut. The prothoracic segment is broad and flattened, the prothoracic shield very large and thick, of the same color as the head. The body is pale flesh-colored; across the front of each segment is a broken reddish-pink line of spots, while on the end of each segment is a conspicuous broad band of the same color. The piliferous warts are dark and conspicuous, giving rise to a long slender hair, some of them as long as the body is broad, or a little longer. In some specimens the piliferous warts are almost reddish.

The subsequent changes are probably of little interest, as the adaptation of form to burrowing habits, so striking in the fully-developed larva, is already exhibited in the freshly-hatched caterpillar.

#### IV.—*A Study of the New York Obelisk as a Decayed Boulder.*

BY ALEXIS A. JULIEN.

Read April 24, 1893.

##### LITERATURE.

- Bolton, H. Carrington. Scientific jottings on the Nile and in the desert. Transactions of the New York Academy of Sciences, IX (1890), 110-126.
- Cooley, James Ewing. The American in Egypt, with rambles through Arabia Petræa and the Holy Land. New York, 1842.
- Dalrymple, Donald. Meteorological and Medical Observations on the Climate of Egypt. London, 1861.
- Delesse, A. Sur la syénite rose d'Égypte. Bulletin de la Société Géologique de France. 2<sup>e</sup> Série, VII (1850), 484. Paris, 1850.
- Description de l'Égypte, ou Recueil des Observations et des Recherches qui ont été faites en Égypte, pendant l'Expédition de l'Armée française. Paris, 1809.
- Coutelle, J. M. J. Observations Météorologiques faites au Kaire en 1799, 1800, et 1801. Histoire Naturelle, Texte, I, 334.
- Gratien-le-Père. Mémoire sur la Ville d'Alexandrie. État Moderne, III, 279.
- Jomard, Edmé Francois. Description de Syène et des Cataractes. Description. Mémoires, I, 61.
- Nouet. Observations Météorologiques et Hygrométriques faites dans diverses Villes de l'Égypte. Histoire Naturelle. Texte, I.
- Draper, Daniel. Abstract of Registers: New York Meteorological Observatory of the Department of Public Parks, Central Park. New York, 1880-1889.
- Dudley, P. H. Transactions of the New York Academy of Sciences, V (1885), 67. New York, 1886.
- Egleston, Thomas. The Disintegration of the Egyptian Obelisk in the Central Park, New York. American Society of Civil Engineers, XV (1886), 79-84. New York, 1886.
- Foissac, Pierre. De la Météorologie dans ses rapports avec la science de l'homme. Deux tomes. Paris, 1854.
- Frazer, Persifor. Cleopatra's Needle: Mineralogical and Chemical Examination of the Rock of the Obelisk, lately transported to New York by Lieut.-Commander Henry H. Gorringe, U. S. N. [From Transactions of the American Institute of Mining Engineers, XI (1883), 353-379.] New York, 1883.

- Lane, Edward William. *Account of the Manners and Customs of the Modern Egyptians*, 1833-35. Fifth edition. Two volumes. London, 1871.
- Lefèvre. *Bulletin de la Société Géologique de France*. 1<sup>e</sup> Série, X (1838). Paris, 1839.
- Lebas, Jean Baptiste Apollinaire. *L'Obélisque de Luxor; Histoire de sa Translation à Paris*. Paris, 1839.
- Lepsius, Karl Richard. *Letters from Egypt, Ethiopia, and the Peninsula of Sinai*. Translated by L. and J. B. Horner. London, 1853.
- Lockyer, J. Norman. *On some Points in the early History of Astronomy*. Nature, Vols. 43, 44, and 45. London, 1891.
- Mariette-Bey, Auguste Edouard. *Karnak: Étude Topographique et Archéologique, avec un Appendice comprenant les principaux Textes hiéroglyphiques*. Planches. Leipzig, 1875.
- Newbold, Lieut. *On the Geology of Egypt*. *Proceedings of the Geological Society of London*, June 29, 1842 (See *Quart. Jour. Geol. Soc. London*, IV (1848), 324).
- Petrie, W. M. Flinders. *Kahun, Gurob, and Hawara. Memoir of Egyptian Exploration Fund*. London, 1890.
- Poole, R. S. *Encyclopedia Britannica*. Article "Egypt." VII.
- Report on the Condition of the Obelisk in Central Park, New York, by Committee of Experts appointed by the Department of Public Parks*. Extracted from Official Documents of the Board. Document No. 118. June 18, 1890. New York, 1890.
- Savary, Claude Étienne. *Letters on Egypt*. Translated from the French. Two vols. Second Edition. London, 1787.
- Shaw, Thomas. *Travels or Observations Relating to Several Parts of Barbary and the Levant*. Oxford, 1738.
- Stelzner, Alfred. *On the Biotite-holding Amphibole-granite from Syene (Assuan)*. *Transactions of the American Institute of Mining Engineers*, XI (1883).
- Volney, Constantin Francois Chassebœuf, Comte de. *Travels through Syria and Egypt, in the years 1783, 1784, and 1785*. Translated from the French. Two vols. London, 1787.
- Wigner, G. W. *Analyst*. London, 1878.
- Wilkinson, John Gardiner. *Topography of Thebes and General View of Egypt*. London, 1835.
- Wilkinson, John Gardiner. *Thebes and Pyramids. Topographical Survey of Thebes. Maps*. London, 1830.
- See also List of Literature preceding my paper on  
*The Misfortunes of an Obelisk. Bulletin of the American Geographical Society*, XXV (1893), 66. New York, 1893.

---

To the geologist, musing over a rusty coated, ice-scratched pebble—picked up, perhaps, the other day in Central Park, not far from the base of the Obelisk, or over some huge boulder, which, on tap

of hammer or thrust of cane, tumbles at once into fragments, a fascinating but most perplexing problem is offered in trying to unravel the vicissitudes of its past history. Through the work of Dolomieu, T. Sterry Hunt, and others, we have caught some glimpses of its quiet youth, when, locked up within the original rock-stratum, its rounded form was first slowly etched out by the underground gnomes—the forces of subterranean disintegration and chemical decay.

Then followed the stirring experiences of its middle age, when, in our latitude, torn out by torrent or by the continental glacier from its softened bed, it was rasped by partly decayed and angular gravel, hurled down deep fissures, crushed under the enormous weight of thousands of feet of ice, jammed against other boulders, ground down over the rocky glacier-bottom, and at times rolled over and over in the rush of a glacier-river.

At last came old age, when, stranded upon the surface of the land, it was drenched by rains or melting snow, repeatedly surface-dried by intense heat of summer's sun, even roasted at times by passing forest-fires, frozen and thawed again and again, and soaked in organic acids from soil or swamp, until completely changed in molecular arrangement, and partly in material, through and through.

Within, by absorption of oxygen and water, and consequent production of new salts and combinations of increased molecular volume, the entire aggregate of mineral crystals remained locked in intense strain, the relief attained by partial closing of old joint-planes having been offset by development, through such minerals as the feldspars, of innumerable fine clefts and spongy vacuoles.

Without, by the insinuation of water and thrusting force of frost-crystals, the co-adherence of the grains was loosened, the inner strain largely relieved, and the outer part of the boulder expanded in a series of coats, successively softer, more porous and swollen toward the exterior.

So at last the successive crusts have tended to exfoliate and fall away, until many an aged boulder has crumbled to fragments and dust, with its story forever untold.

In the case of some particular boulder, the student may often make out part of this history, its original site and source, its glacial experience, the distance of its transport, etc.; but as to the exact agents of decay, their relative efficiency, and, especially, the duration of the trial, he possesses no measure and can make no estimate.

If only some boulder could be found whose whole story was known, whose hieroglyphic striæ could be entirely interpreted!

It has occurred to me that on many of these points we may be able to gain some facts of value through a special study of at least one huge block of hewn granite, whose known but vast antiquity renders it, to some degree, comparable with a natural boulder, while its record of varying experiences of natural and artificial agencies of destruction is quite definitely known. A recent re-awakening of public interest in the Egyptian Obelisk, now in Central Park, New York, and of anxiety as to its permanent preservation, led to the appointment, in 1890, by the Board of Commissioners of the Public Parks, of two successive Committees of Experts to consider these subjects. Service on these committees gave me the opportunity of commencing a series of experiments, whose continuance, at intervals, during the last three years, has yielded the results presented in this paper.

Moreover, the Nile valley, as well as the streets and squares of European capitals, is strewn with similar Egyptian boulders, of huge size and of the same homogeneous granite, which have long lain in definite positions, exposed to known agencies of geological change, during periods coeval with the establishment of ancient dynasties, often yet plainly recorded upon their faces. For at least the partial elucidation of our problem, we are fortunate to possess, in this peculiar class of historical monuments, a happily arranged series of trial-boulders of approximately known age and tests.

The history of the Obelisk is naturally divided into four periods, corresponding to the four sites it has occupied: Syene (Sun-t or Assouan), where it was quarried; An (On or Heliopolis), where it stood erect for about 1050 years, and then perhaps lay prostrate for 513 years longer; Alexandria, where it stood for 1893 years; and New York, where it has fought with the elements for over 12 years, since its re-erection, January 22, 1881.

## I. SYENE.

At this point, 560 miles north of Cairo, the great range of the Libyan Mountains, called the Gebel Silsilih, "Mountain of the Chain," is crossed by the Nile through a narrow gorge. Above, its obstruction of the waters of the river, with a chain, as it were, of rocky ledges, forms the famous First Cataract. In these moun-

tains, on the east side of the river, a short distance above the present village of Assouan, lie the old quarries of Sun-t ("Entrance giver") of ancient Egypt, which yielded the so-called "oriental granite," "syenitic marble," or "Thebaic Stone," out of which nearly all obelisks and colossi were cut. This was the "machet" or "mahet," "heart-stone," of the old Egyptians, so-called, it may be, on account of its hardness and durability,<sup>1</sup> perhaps in connection with its bright red color. For the same reason, on account of its flame-colored crystals of microcline, the Greeks afterward called it *pyropæcilon*, the fire-variegated stone.

### 1. *Mineral constitution of Syene granite.*

According to the observations of Russegger, as Prof. Alfred Stelzner states:

"The structure and composition of the 'Oriental granites' are very variable. Coarsely granular varieties, made porphyritic by microcline<sup>2</sup> crystals, which are distributed without regularity in the main mass, seem to be the most usual. They occur immediately in the neighborhood of Syene (Assuan). Out of these are developed locally (for instance, on the road along the cataracts of Syene) such coarsely granular masses, that the individual feldspar and quartz constituents reach the size of a cubic foot; in other places, the size of the grains diminishes, and then there results, by a parallel arrangement of the flakes of mica, a gneissoid rock. Among the varieties of composition three are especially given. That which seems to be most widely distributed is an amphibole-granite, containing biotite, in the composition of which microcline,<sup>2</sup> oligoclase, quartz, amphibole, and biotite take part. Some of the principal localities for this are the old quarries near Syene, and, besides this, Djebel Gareb and Djebel Ezzeit. This principal rock, by the gradual diminution of its hornblende, either merges into normal biotite-granite, which may be either rich in mica (east side of the hill on which the town of Syene is built) or poor in mica (Debu); or it passes, by disappearance of its quartz and the predominance of its hornblende, into normal syenite."

By the last term, Stelzner refers to the combination of microcline (or of orthoclase) with hornblende, free from quartz, to which the German petrographers now confine the name syenite. The porphyritic hornblendic granite of the old quarries of Syene varies also

<sup>1</sup> Lenormant, op. cit., 25.

<sup>2</sup> Frazer, loc. cit., 367.

greatly in lithological constitution. Commonly it consists of bright red to yellowish red microcline in large twins; white oligoclase, sometimes yellowish or greenish; smoky and gray quartz; black biotite, sometimes brown or green; the last often replaced in part or altogether by black amphibole. Less commonly occur yellow mica, pyrite, magnetite, and dark brown garnet. Hematite in hexagonal or rhombic reddish plates, yellowish red titanite, colorless apatite, zircon, viridite, and yellowish green needles of pistazite have also been detected. Newbold also reports:<sup>1</sup> "Schorl, black and green, and actinolite are minerals occasionally found in the granite of Upper Egypt, as well as the chrysoberyl."

In the quartz, Stelzner also distinguishes capillary black needles, which I have recognized as rutile; and in its larger grains, cloud-like zones of fluid cavities, in the smaller of which the bubbles show invariably more or less motion. To this I can add, from examination of my own thin sections of rock from the Obelisk, that the fluid contents of these cavities consist sometimes of brine, sometimes of liquid carbon dioxide. Delesse attributes its smoky tint to the presence of a very small quantity of organic matter.

As to the proportion of the main constituents, the following percentage results have been reported:—

|                      | By volume. <sup>2</sup> | By weight. <sup>3</sup> |
|----------------------|-------------------------|-------------------------|
| Mica . . . . .       | 4                       | 36                      |
| Quartz . . . . .     | 44                      | 33                      |
| Microcline . . . . . | 43                      | } 31                    |
| Oligoclase . . . . . | 9                       |                         |
|                      | <hr/> 100               | <hr/> 100               |

In my examination of the four sides of the Obelisk in 1890, while hanging in a chair from its summit during several days, I recognized, in addition to the common constituents already named, the occasional presence of magnetite, and, on the upper part of the N.N.E. face, very rare particles of pyrite, giving rise to slight ochreous rings of decomposition.

## 2. *Distribution and condition of minerals on the surface of the Obelisk.*

In examining the W.N.W. face of the shaft, black mica was found to be specially abundant, in bright scales in large part inclined about

<sup>1</sup> Newbold, loc. cit., 340.

<sup>2</sup> Delesse, loc. cit., 489.

<sup>3</sup> G. W. Wigner, loc. cit.

45° toward the north. Occasional large bunches of granular hornblende occur, elongated, with their major axes inclined to the N.N.E., marking the original bedding plane of the granite. The microcline crystals are often 1 inch long by  $\frac{1}{2}$  to  $\frac{3}{4}$  of an inch wide, with high lustræ on many fresh faces. Those of the white feldspar (oligoclase) were occasionally bright, but, in larger part, dull and whitened. However, I was rarely able to detect fine cracks in any of the feldspar, even on the old weathered surface. Near the bottom of the shaft occurs a thin seam of hornblende-gneiss, several yards in length, dipping sharply toward the north like the vein at the bottom of the E.S.E. face.

On the N.N.E. face of the shaft, the feldspar generally looked dull, except on small half inch cleavage-planes, here and there. Many masses of hornblende occur, all of dull black color, but without products of decay. A small bunch of pyritous material, nearly 2 cm. in length, was seen, blackened and dull. A large crystal of white oligoclase, 2 cm. long, was covered with a dull white crust, 1 mm. in thickness. In and around the two cartouches of the second row from the top, a large amount of hornblende occurs. At the two cartouches of the third row, below the middle of the shaft, the decay and dropping out of mica scales have caused much pitting of the surface.

On the E.S.E. face of the shaft, between the legs of the middle bull, a streak of hornblende-gneiss occurs, 10 cm. in length, with a dip of 35° to the north; others are found in that vicinity, with the same inclination. Most of the feldspar presents a waxy lustre (in part due to the paraffin absorbed during the water-proofing treatment in 1885), with occasional cleavage-planes of microcline, showing bright lustre; in places, however, below, the feldspar is often of brownish red rusty appearance. Between the two cartouches of the second row, across the body of the owl, runs a black seam of hornblende-gneiss, two feet in length. A little above a lower cartouche, in the north column, are rusty stains, like those from decomposing pyrite; the feldspar grains are sprinkled with bright red spots; and the surfaces of the oligoclase crystals are dull white and pitted. The bottom of this cartouche is crossed by a lenticular black mass of hornblende-gneiss, dipping about 40° to the north; smaller ones occur beneath. Below this, fresh and bright surfaces of oligoclase were noticed, but it was generally dull and whitened; and indeed the feldspar planes, all the way down this side, are often softer and



more inclined to powder than on the north side. At the bottom of the shaft occurs the great seam of hornblende, of which the cleft has now been partly filled with cement.

On the S.S.W. side of the shaft, at the top, the feldspar and mica appear bright on all the fresh surfaces. About a third of the way down, near the second row of cartouches, the red microcline, quartz, and mica continue to be wonderfully bright and glittering; the feldspar crystals sometimes 3 inches long by  $\frac{3}{4}$  of an inch wide, and the quartz in occasional flakes, 3 to 4 inches long. A small lens of hornblende-gneiss, 2 inches long, was seen just below the pyramidion, but none further down. About 22 feet above the bottom of the shaft, the grains of quartz and feldspar are often bright, and apparently with as few cracks as in any fresh granite; the feldspar crystals are salmon-colored to pink, generally  $1\frac{1}{4}$  inches long by  $\frac{1}{4}$  to  $\frac{1}{2}$  inch wide, and some show dull lustre. The white grains of oligoclase are here abundant, dead-white and covered with snow-white films (calcium carbonate?), forming irregular dull spots,  $\frac{1}{8}$  to  $\frac{3}{4}$  inch in length. Many little flakes of black hornblende here occur, apparently as numerous as those of black mica, and often surrounded by ochreous particles and spots. The scales of black mica are shining and flat, and never show curling. Along the bottom of the lowest cartouche, in the east column, near the bottom of the shaft, the black streaks consist of flakes of black hornblende. A crystal of microcline was noticed below, with pale altered edge.

In regard to the distribution of the biotite and hornblende on the four faces of the Obelisk, I found that it varies greatly, biotite in general largely replacing the hornblende. Where the latter occurs, it may be alone and scattered in grains, or intermixed and closely interpenetrated with biotite, or concentrated in large masses, often lenticular in outline, or thinning out at one or both ends into wedge-like seams. In these masses, the plates and bunches of hornblende, as well as of any biotite intermixed, are arranged in nearly parallel planes; so that, in fact, they present all the features of intermixed masses of hornblende-schist, more or less biotitic. Still further, the planes of these schist-enclosures lie very nearly parallel, so that this obelisk-mass presents to us the last stage of a transition of hornblende-schist into a gneissoid hornblendic or biotitic granite. The most extensive of these enclosures of hornblende-schist is that near the base of the shaft which forms a narrow black seam running up the W.N.W. face, and, on the E.S.E. face, has in olden time partly

weathered or fallen out and formed the well-known rift or notch<sup>1</sup> at the east base, partly filled and pointed with cement, at the time of the treatment of the Obelisk in 1885.

There is an interesting correspondence, in both constitution and origin, between the rocks of New York Island and those of Syene. The so-called "Graywacke Knoll," on which the Obelisk now stands, consists of biotitic hornblende-schist and gneiss, closely resembling the black seams in the monolith. This mass is crossed by a vein of coarse endogenous granite, very similar in places to that of the Obelisk itself, which is now covered by the western steps leading up to the platform; some branching seams of this granite still project on the sides of the steps. On account of this resemblance, except in the brighter red color and porphyritic character of the Obelisk-granite, a box of fragments of rubbish from this vein was kept at hand by the workmen, at the time of the waterproofing of the monument in 1885, to satisfy the constant demands of visitors from all parts of the country for specimens from the monument, and admirably answered the purpose to the gratification of both parties.

It would appear that the strongly marked bedding, apparent in photographic views of the old quarries at Assouan, and in conformity with which all the obelisks were hewn, is not, at least in all cases, the true plane of original stratification. This bedding plane is shown in the gneissoid structure of our Obelisk and now stands upright in the shaft. But, to the geologist's eye, the New York Obelisk is merely a long block of biotitic, porphyritic granitoid gneiss, in part hornblendic, crossed by seams and lenticular nodules of black hornblende-schist, whose lamination (probably signifying the true original bedding) now happens to be set up, so to speak, with a strike of W.N.W. to E.S.E., and a dip of 40° to N.N.E.

### *3. Entasis of E.S.E. face of the New York Obelisk.*

While here discussing the locality and original source of the material of Egyptian obelisks, we may refer to one feature of the New York monolith to which my attention was first called by Prof. R. O. Doremus, a slight curvature, longitudinally convex, of its present E.S.E. face. On farther examination, there appeared to me, also, a very slight lateral convex curvature of the same face,

<sup>1</sup> Gorringer, op. cit., 12.

from each edge up to a central line; but the opposite (W.N.W) face appears to be plane and its edges straight. The exact determination of this point could not be well carried out from my unsteady position in a swinging boatswain's chair.

A corresponding curvature or entasis has already been noticed in several Egyptian obelisks. In the northern erect Obelisk of Queen Hatasu at Karnak, a decided convexity of at least one of its faces was observed by Verninac St. Maur.<sup>1</sup> In the Obelisk of Thothmeses III, now in front of the Church of St. Giovanni in Laterano, at Rome, of which the shaft is 105 feet 7 inches in height, the western face is slightly convex, and the pyramidal finish at the top has a small convexity on each of the four sides.<sup>2</sup> But the best known and most marked entasis occurs in the two obelisks of Luxor (of which the western is now at Paris). In each, the N.W. and S.E. sides are convex, to an extent of 0.030 and 0.035 meter<sup>3</sup> respectively ( $1\frac{1}{8}$  and  $1\frac{1}{3}$  inches), at the middle of the rounding, measured from a straight line across from edge to edge. In regard to the object of this curvature, Wilkinson states:<sup>4</sup> "The faces, particularly those which are opposite to each other, are remarkable for a slight convexity of their centres, which appears to have been introduced to obviate the shadow thrown by the sun, even when on a line with a plane surface. The exterior angle thus formed, by the intersecting lines of direction of either side of the face, is about  $3^{\circ}$ ." Both the Luxor obelisks, however, have also a longitudinal curvature of the same two faces, amounting to 0.020 and 0.045 meter respectively, in the Paris Obelisk, that on the N.W. face being convex and that on the S.E. concave. Hence all their longitudinal edges are convex to the N.W., *i. e.*, toward the Nile. By Prof. Donaldson<sup>5</sup> these curvatures are looked upon merely as defects in quarrying, as he states: "I imagine that the first block must have been irregularly marked out and worked, and the second one compelled to follow the faulty line in the quarry."

In regard to this feature in the New York Obelisk and those of Luxor, I think it probable that at least longitudinal curvatures, especially if with corresponding concavities on opposite side of the blocks, may be but instances of tendency to curvature in splitting, commonly observed in natural joints of granite and on the longer

<sup>1</sup> Gorringe, *idem*, 121.

<sup>3</sup> Lebas, *idem*, 63.

<sup>5</sup> Parker, *idem*, 33.

<sup>2</sup> Long, *idem*, 336.

<sup>4</sup> General View of Egypt, 167.

faces and bedding-planes of its quarries; of this some evidence seems to be shown in photographs of ledges in the Syene quarries.

It may be added that there is abundant evidence in the old quarries of Syene of the great care and economy with which the Egyptians worked their highly prized "heart-stone," and therefore of the probable good condition in which their hewn blocks were delivered ready for transport. But natural flaws occurred in the stone, and the unequal strains produced by rude methods of quarrying may have occasionally resulted in injury to some of the larger blocks, *e. g.*, the apparent cross-fissure in the famous partly hewn quarry-obelisk. Such defect may be now represented in local weakness in parts of the New York Obelisk and others, and in fractures to their pyramidia.

The most noted example was the cracked base of the western obelisk at Luxor, discovered, on the arrival of the French, by the hollow sound it yielded to a gentle blow of a hammer.<sup>1</sup> This caused the engineer Lebas, at the time, great dismay and embarrassment, lest he might afterwards be charged to have cracked the obelisk while lowering it from its pedestal. The main fissure was twelve feet in length, running along about one-sixth of the length of two of the faces (as now shown in photographs of the Paris Obelisk). It was "crossed by two dove-tailed mortises, filled with a yellowish dust, the remains of wooden dogs, which must have been driven in, before the erection, to prevent any possible widening of the crack."

#### 4. *The nick in the north-northwest edge.*

About half-way up the shaft, on the N.N.W. corner or edge, a peculiar deep nick occurs, easily remarked from below, which also appears in all photographs of adjacent faces of the monolith, taken while it stood at Alexandria, previous to 1879. This seems heretofore to have escaped particular attention, doubtless because it has been considered a mere defect, like others of smaller size along that and other edges of the shaft. I had opportunity to examine it with some care, during my trips in the hanging chair up and down the adjacent sides, and found it to possess quite a symmetrical form, that of a quarter section of a hemisphere. The height of the little curved vault of the cavity is 7 inches, and the depth of its floor, measured from the angle (radius of the hemisphere), 5 inches.

<sup>1</sup> Lebas, *idem*, 45.

Through the rock in its vicinity small bunches of black hornblende are scattered, but none on the sides of the cavity. It does not therefore appear to be the result of weathering away and dropping out of any hornblende-mass or of other ordinary products of decay; and its outlines do not conform to the natural cleavage of the stone. Its peculiar shape, and its position—which is, I believe, exactly half-way up the shaft, suggested the possibility that it may have been an ancient artificial cut, perhaps a niche or shrine excavated for the reception of a small golden image of some deity. If so, whether this was done during the construction of the shaft at Syene, or by Egyptian, Greek or Roman, at later date, at An, can now be but a subject of conjecture. No corresponding cavity appears in photographs of other Egyptian obelisks, however, nor in that of the fellow-obelisk now in London.

#### 5. *Decay of granite at Syene.*

A general opinion has long prevailed that the climate of Syene is one not only of extreme heat, but of unvarying aridity, and that its rocks are consequently fresh and free from any but the most superficial decay.

Thus Jomard,<sup>1</sup> in 1809, refers to Syene as “a place surrounded on all sides by naked and browned rocks; a burning sky, never tempered by a drop of rain. Martial has characterized in a single line this aridity and this sombre color of the ground:

‘Seis quoties Phario madeat Jove fusca Syene.’<sup>2</sup>

If you break off a chip from these dark colored rocks, you are surprised to see the rose-colored and brilliant tint which the fracture has revealed. You wonder whether it is the action of the air or that of the sun to which the surface owes its brown and deep color. But what could an atmosphere of perpetual dryness produce on so hard a material? And, as to the heat, one can hardly attribute this effect to it, except on the supposition of a period of prodigious length; because the hieroglyphs inscribed on these rocks for a long time are still of a quite bright rose-color.” Elsewhere he explains that the wedge-marks and hewn surfaces in the granite quarries still retain the same bright color. Lefèvre,<sup>3</sup> in 1838, refers to the more ancient syenite forming “cliffs resembling heaps of

<sup>1</sup> Jomard, *op. cit.*, I, ch. ii, 61.

<sup>2</sup> Epigramm, Bk. IX, epigr. 36.

<sup>3</sup> Lefèvre, *loc. cit.*, 144.

rounded altered blocks," and Delesse also states,<sup>1</sup> "Near the cataract, the separated blocks of syenite have sometimes a spheroidal form, and they disintegrate in concentric layers." Lieut. Newbold also reports:<sup>2</sup> "The granite of Egypt is freer from the decay, the *maladie du granit*, than that of India, arising probably from the peculiarly dry atmosphere of Egypt, which has been mainly instrumental in preserving, almost in their original freshness, its magnificent sculptures and vivid frescoes."

As to the climate, however, there is abundant evidence of past exaggeration of its arid character, and of the occurrence of heavy falls of rain, though at long intervals, as well as of the constant heavy dews. These render it certain that the action of water in erosion, infiltration, and hydration has ever played a slow but important part in effecting decay of the rock in that region.

For example, Lepsius relates, in his account of travel through Egypt, that he encountered at Assouan a violent thunder-storm, with heavy rain, which afterwards rolled down the Nile valley for nearly 600 miles, as far as Cairo.<sup>3</sup>

Concerning the Libyan hills, Ebers also states:<sup>4</sup> "From time to time—rarely indeed, and in most cases only once a year, in the winter months—dark storm-clouds gather around the heads of the mountains; and soon the rain pours down with such violence, on the hill country, that it seems as if all the collected vapors of the year were being restored to the earth in one tremendous torrent. The brooks and cascades that tumble down the rifts and crevices in the mountains collect in the valleys; the streams form a regular system of little rivers; and at last, gathering in one main valley, the flood rolls on, either slowly and majestically, or vehemently, ruining all it meets with on its way, till it loses itself in the Red Sea or the Nile."

Further data on this subject are given beyond, in the notes on the climate of Alexandria (Section 11).

It is also apparent, by a study of views and photographs from this region and of references to its scenery by passing travellers, that the picturesque character of the vicinity of Syene is mainly due to the extent and character of general rock-decomposition which there prevails. Thus Denon,<sup>5</sup> in 1802, describes the scenery

<sup>1</sup> Delesse, loc. cit., 488.

<sup>2</sup> Newbold, loc. cit., 340.

<sup>3</sup> Lepsius, Letters from Egypt, 119.

<sup>4</sup> Ebers, op. cit., II, 333.

<sup>5</sup> Denon, op. cit., 83.

near the First Cataract: "These mountains, all bristling with black and sharp projections, cast their sombre reflections in the waters of the stream. . . . After passing the cataracts, the rocks grow loftier, and, on their summit, blocks of granite are heaped up, appearing to cluster together and to hang in equipoise, as if with the purpose of producing the most picturesque effects. Through these rough and rugged forms, the eye all at once discovers the magnificent monuments of the Island of Philæ." Miss Amelia B. Edwards<sup>1</sup> also refers to the same scene: "Perhaps the most entirely curious and unaccustomed features in all this scene are the mountains. . . . Other mountains are homogeneous and thrust themselves up from below in masses suggestive of primitive disruption and upheaval. These seem to lie upon the surface foundationless; rock loosely piled on rock, boulder on boulder; like stupendous cairns, the work of demi-gods and giants. Here and there, on shelf or summit, a huge rounded mass, many tons in weight, hangs poised capriciously."

The peculiar features which mark an extensive, deep and long continued decay of rock in place are well shown in the accompanying illustration, from a photograph made by my friend, Dr. H. Carrington Bolton, of a granite-cliff about 2 miles south of Syene (Pl. IV). We have here all the indications of a slow decay, progressing most rapidly along the planes of bedding and jointage, also eating out the latent lines of shrinkage and weakness, and so dividing the whole mass into angular fragments, with slight adherence, only remaining in place by gravity, like the boulders in a stone-wall. Exfoliation has partly rounded the angular blocks at their corners and edges, even in position; while those on the crest, and those that have rolled out into full exposure to sun and to night-radiation, have been largely rounded off into true boulder form.

[At this point a series of recent photographs was exhibited, including the following: View of the First Cataract from the S.W., with deeply etched and roughened boulders and tops of columns, on the crest of the cliff in the foreground: View of an old watch-tower near Syene, showing horizontal bedding and strong joints in the cliff, and several well rounded boulders, with surface scaling off in successive coats: Frith's view of Philæ, from the head of the cataract, on the north, showing the deep erosion of the strong joints,

<sup>1</sup> Edwards, *op. cit.*, 231.

and etched surfaces of rounded boulders, near the level of the river : Views from Philæ to the N. and to the S.W., showing development of columnar structure by the decay, in the direction of the strike, and formation of elongated boulders : Views of Philæ from the E. and from the S.W., showing the eroded columns of "Pharaoh's Throne," rounded ledges, with hard seams (of quartz?) projecting above the eroded surfaces, and huge exfoliating boulders.]

These forms are so familiar to the geologist's eye, as characteristic of rock-decomposition in a climate of heavy rainfall and winter frosts, that it is at first hard to believe that these occur in one of the most arid regions on the globe, where frost is unknown. The topographical features suggest the probability that, throughout the entire upper stratum of granite, to which the Egyptian quarrymen were compelled to limit their exploitation, not exceeding a thickness of 60 or 70 feet, the stone was already quite uniformly affected by a kind of "dry rot." Further light on this matter will be presented beyond, in physical tests made on the freshest stone I have been able to procure from the Assouan quarries.

To Villiers Stuart<sup>1</sup> we owe an archæological observation at the First Cataract, whose geological importance seems to have been overlooked: "We landed at the island of Schael, just below the falls, to examine the inscriptions on the rocks; they are very numerous and curious, and extend over a period of 2000 years. The earliest we saw was of Ousertasen the Third, of the XIIth dynasty (2200 B. C., Lepsius) . . . There is a special interest about Ousertasen's, for it was inscribed while the Nile was still at its original level, 23 feet higher than now; and accordingly it stands high upon the rocks. . . . They are all cut in granite, and Ousertasen's showed its great age by the fact that a process of decay in the granite itself had set in, the once polished surface being corroded and eaten by the tooth of time, and the outlines somewhat blurred. High up among the loftiest rocks of the island, however, I found another inscription and a statuette cut in bold relief in a niche which must have been much older even than Ousertasen; the granite had so entirely decayed that the features of the statue had dissolved and were undistinguishable. There were many lines of hieroglyphics in like manner quite decayed and illegible. No clue therefore existed to the date except the condition of the stone,

<sup>1</sup> Nile Gleanings, 203.



which, though in a sheltered angle of the rocks and less exposed than Ousertasen's, was much further gone. It may have been of the Pyramid period" (IVth dynasty, 3124–2840 B. C., Lepsius). This would involve an exposure of 50 or more centuries.

On the other hand, Delesse states:<sup>1</sup> "In the Egyptian Museum of the Louvre, the feet and the head of the colossal statue of Amenophis III, as well as a large number of sculptures, which, under the perpetually pure sky of Egypt, have not experienced any alteration during the greater part of the time, have even preserved the most perfect polish after nearly 4000 years."

From all these observations at Syene, the following conclusions may be drawn:—

(1). The predominant destructive process has not been external, such as disintegration by the heat of the sun, attrition by sand whirled by the wind, etc.; here, as elsewhere, these have played a secondary part. A certain degree of polish has been produced on the surface of ledges by sand-attrition, by occasional heavy rains, and by the mud-laden waters of the Nile up to the limit of its flood-line.

(2). The main process has been one of internal decay, most efficient along the joint- and bedding-planes of the granite, even to the lowest depths now observable, and producing long columnar masses. The chemical decay and disintegration have also seriously attacked the irregular planes of contraction and eaten them out into an irregular network of fissures, which mark the latent lines of weakness throughout the material, and divide it into angular blocks.

(3). The gradual decomposition of the ferruginous silicates over the surface of the ledges (biotite, hornblende, and the feldspars) has left their feebly soluble bases, in this arid climate, as a polished black crust of iron and manganese oxides. The other more soluble and finer products of decay have been removed by occasional rains and constant action of the wind.

(4). The outer forms assumed by the cliffs largely indicate their variation in materials and in their resistance to decomposition and erosion: the projecting masses consist of the more compact kinds of granite and porphyry, and even thin projecting seams and nodules of quartz: the hollows and fissures, of softer granite and of intercalated seams of hornblende-schist. A considerable internal expansion of material is shown by the general scaling of the surface and

<sup>1</sup> Delesse, loc. cit., 490.

rounding of angles and edges. The predominance of these rounded forms in loosened and isolated blocks, and in the projecting tops of columns, probably signifies the efficient help of the heat of the sun and of alternations of temperature.

(5). As to the amount of degradation of the surface, we may probably get some estimate through the observations of Stuart on the effacement of the older hieroglyphs on the island of Schael. Since the ordinary depth of such carvings is from 2 to 4 centimeters, we may infer that the granite has decayed in these places, during the period which has elapsed since their execution, from 40 to 50 centuries, to the depth of at least 1 centimeter and perhaps over 2 centimeters.

It must always be a subject of regret that Commander Gorringe, during his stay at Alexandria for the removal of our Obelisk, was not able to visit this region and to become impressed with the universal and deep decay prevailing throughout this durable rock of Syene. In that case, it is probable that he would not have replied, as in 1880, to a suggestion of the need of the New York Obelisk of protection from the weather by some preservative: "It has lasted nearly 4000 years and will probably last 4000 more. I think we need not trouble ourselves about it."<sup>1</sup> It was but a repetition of the mistake of his predecessor, Rameses II, who, in his invocation to the gods, recorded in the poem of Pen-ta-our, alludes to the "eternal stones" which he has erected in his temples to their honor.

## II. AN.

The next step in the history of our Obelisk was its conveyance from Syene to the ancient city of An (or Heliopolis, as the Greeks called it), near the site of the present Arab village of Mataria, about 6 miles N.E. of Cairo.

### 6. *Position of our Obelisk at An.*

This city of An was built upon a somewhat raised, artificial platform, extending over an area (according to Mariette-Bey) of about 4560 by 3450 feet. Here our Obelisk, together with its companion, now in London, was raised before the Temple of the Sun by Thothmeses III of the XIXth dynasty, about the year 1600 B. C. As

<sup>1</sup> Report on Condition of Obelisk, 4.

to the situation of the great Sun Temple, and of the great gate or propylon standing before it, archaeologists agree in assigning it to the western part of the city, toward the Nile and the setting sun. The English traveller, Pococke, in 1743, traced out the boundaries of the mounds, as indicating the outlines of the ancient city. Brugsch, however, maintains that these mounds show only the limits of the walls of the temple, and are themselves but the remains of the walls of a Coptic town which occupied the site of the temple, a few centuries before our era.

The temple was specially devoted to Atum-Ra or Tum, the God of the Setting Sun. Before the great propylon, in approaching it from the west, rose a pair of Obelisks of Usertesen I of the XIIth dynasty, probably erected about 2300 B. C., fully 700 years before our own monolith. Pococke located these almost opposite to the passage through the mounds which he considered to be the west city gate, but a little more to the south. One of the pair fell in 1160 A.D., having been undermined by treasure-hunters, and has long disappeared. It was perhaps last seen prostrate in 1753 A.D., by Robert Clayton;<sup>1</sup> of the present erect shaft, Savary stated in 1787, "this and one sphynx of yellowish marble, thrown in the dust, are the only remains of Heliopolis."<sup>2</sup>

Passing next through the propylon and between two rows of marble sphynxes, the temple itself was reached, with two pairs of obelisks before it. The pair next the portal of the temple was the more ancient, consisting of the monolith which now stands at Constantinople (the Atmeidan Obelisk, with its lower end broken off, but still  $55\frac{1}{2}$  feet in height), and of a missing companion, of whose fate nothing is now known. The outer pair consisted of the obelisk now at London, on the right (S.W.), and of our own Obelisk on the left (N.E.).

#### 7. *Orientation of sides of our Obelisk at An.*

In regard to the position in which the sides of the Obelisk were then placed, a consideration of the inscriptions within the pictured squares on the four faces of the pyramidion throws some light. In those of the present N.N.E. and E.S.E. faces,<sup>3</sup> the King Thothmeses is represented in the form of an androsphynx, worshipping the God of the Rising and Noon-day Sun, *Hor-Khuti-Ra*. In the

<sup>1</sup> A Journal from Grand Cairo, 7.

<sup>2</sup> Savary, op. cit., I, 123.

<sup>3</sup> Moldenke, op. cit., 54 and 47.

pictures of the S.S.W. and W.N.W. faces<sup>1</sup> of the pyramidion, the object of the king's worship is Atum-Ra, the God of the Setting Sun, to whom the Sun Temple at An was specially dedicated, at least during and after the XIIth dynasty, by the re-builder of the sanctuary, Amenembât I. In harmony, therefore, with the purpose and custom of the sun-worship, the former two faces must have been originally so placed, on the erection of this shaft at An, as to have been lit by the rays of the rising sun, and the latter two, by those of the setting sun. The similar pictures on the pyramidion of the London Obelisk intimate that its faces were arranged in a corresponding position. Indeed the same key to the position of their faces is afforded by the similar pairs of pictures on the faces of the pyramidia of several other obelisks.

A more definite indication is probably shown in the position of the faces of the present Obelisk of An, which probably stood in front of the pylon of the Sun Temple, at a site more westerly than that of the New York and London obelisks. As to this, Niebuhr has noted that its angles are now directed to the S.S.E., N.N.W., E.N.E., and W.S.W.<sup>2</sup> Archæologists, however, have pointed out the evidences of a historical catastrophe, in early Egyptian history, unrecorded in the inscriptions, during which, perhaps by a great revolution or invasion, all the monuments, temples, and obelisks of Lower Egypt were overturned; some writers attribute it to invaders, such as the Hykshos, 2398 B. C.<sup>3</sup> Some of the monuments have ever since lain prostrate, *e. g.*, the stela of Begig of Userthesen I, in the Fayoum. Others, like this Obelisk of An and its former companion, were afterwards re-erected by the Egyptians. Their ancient low pedestals, consisting of a layer of sandstone blocks, had been probably undisturbed, and probably guided their re-adjustment in their former and proper position. The evidence of this surviving obelisk on the site of An is therefore that the front of the pylon, the façade of the Sun Temple beyond, and the corresponding western faces of all its six obelisks (if Niebuhr's observation is exact), faced to about W.N.W., *i. e.*, W. 22° N.

We have evidence, in the ancient documents, of a ceremonial attending the foundation of an Egyptian temple, which signified a deliberate design as to the direction in which it was to be laid out;

<sup>1</sup> Moldenke, *idem*, 50 and 52.

<sup>2</sup> Long, *idem*, 316.

<sup>3</sup> Cooper, *idem*, 17.

in this, the King and the God are represented holding stakes upright between them, around which a looped cord is drawn tightly, so as to indicate a definite direction; along the line then shown by the stakes, driven into the ground, a boundary wall of the new temple was erected. In an inscription dating over 2000 years B. C., this ceremonial is related concerning the foundation of this very Sun Temple at An, by the founder of the XIIth dynasty, Amenemhât I, and his son and co-regent, Usertesen I, who afterwards set up the present Obelisk of An:

“Arose the King, attired in His necklace and the feather-crown;  
All the world followed Him, and the Majesty of Amenemhât.

The Kolchyt read the sacred text, during the stretching of the  
measuring-cord and the laying of the foundation-stone on  
the piece of ground selected for this temple.

Then withdrew His Majesty Amenemhât;

And King Usertesen wrote it down before the people.”

As to the intent of the particular direction given to the measuring-cord, we now have a satisfactory explanation through the investigations of Nissen, in 1885,<sup>1</sup> and of Lockyer (op. cit.) in 1891. The varying courses of the axes of different Egyptian temples appear to have been directed to points on the horizon which marked the periodical rising or setting of the sun, moon, or certain stars, particularly at the summer and winter solstices. The apertures in the huge pylons and in the series of separating walls and portals beyond, toward the Holy Place, exactly represent the diaphragms in the modern telescope, and were intended to keep the light pure, from the luminary rising or setting on the horizon, and so lead it directly into the sanctuary at a definite moment. A solar temple was therefore so oriented to the horizon, at a solstice, that, either at sunrise or at sunset, the light of the sun should pour along the axis from end to end. Several of the solar temples were thus directed toward the point of the setting sun at the summer solstice, when the day was longest; and to this class, of course, must have belonged the Sun Temple of Atum-Ra at An. There, once a year, past its double emblem before the pylon, the pairs of obelisks, the sunbeam sped through the huge portal, through the double line of sphynxes and the colonnade of temple-columns, through opened doorways and parted curtains, and flashed through the portal of the dark Holy of

<sup>1</sup> Rheinisches Museum für Philologie, 1885.

Holies as a glittering spot of light upon the end-wall—for a few moments only, it may be, and then vanished away. So began the first day of Thoth, the first month of the Egyptian year. The orientation of the axis, over a quarter mile in length, of the magnificent Solar Temple of Amen-Ra, at Karnak, has been determined with an amplitude of W.  $26^{\circ}$  N.,<sup>1</sup> and that of Abydos, W.  $27^{\circ}$  N. The latitude of Karnak is about  $26^{\circ}$  N., and that of An about  $30^{\circ}$  N., which (according to an approximate calculation made for me by Prof. J. K. Rees, of the Astronomical Observatory at Columbia College, New York) would add about one degree to the amplitude of the sun-setting point at the summer solstice.

Although, therefore, not a single stone remains of the ancient Sun Temple of An, it appears quite certain that its axis was directed to W.  $27^{\circ}$  N., and to that point faced the front side of the New York Obelisk, over thirty-five centuries ago.

#### 8. *The mutilation of the Obelisk by fire.*

After standing, probably undisturbed, for about 1050 years, the Persian Invasion of Egypt occurred, during which, about 525 B. C., the city and Temple of An were destroyed, as related by the geographer Strabo,<sup>2</sup> who visited Egypt 24 B. C.:

"There, too, is Heliopolis, situated on a large mound. . . . At present the city is entirely deserted. It has an ancient temple constructed after the Egyptian manner, bearing many proofs of the madness and sacrilegious acts of Cambyses, who did very great injury to the temples, partly by fire, partly by violence, mutilating in some cases and applying fire in others. *In this manner he injured the obelisks, two of which that were not entirely spoilt were transported to Rome. There are others, both here and at Thebes (the present Diospolis), some of which are standing, much corroded by fire, and others lying on the ground.*"

There are two reasons for believing that our Obelisk and its companion would particularly attract the fierce indignation and attack of the Persians, perhaps above all the others which gave to the city its name of the "City of Obelisks:" first, their prominent position before the façade of the Temple of the Sun: secondly, the names of the two kings repeatedly inscribed in cartouches, among the hieroglyphs over every side of these two shafts.

<sup>1</sup> Compare Map No. 1, Wilkinson, Thebes and Pyramids.

<sup>2</sup> Book XVII, i, 27.

To the westward, for reasons before explained, the present W.S.W. angle of our monolith must have been directed, so that, to one who approached the Temple, the inscriptions on the present S.S.W. and W.N.W. sides first became visible. This conspicuous position might have been sufficient in itself to invoke the special fury of the destroyer. But to this must have been added the intense hatred of the Persian toward the two warlike and ambitious monarchs of Egypt, Thothmes III and Rameses II, who had both in succession, at an interval of two centuries, not only extended the sway of Egypt over Persia, but had subjected the native land of the present invader, Cambyses, to special cruelty and humiliation. We may then fairly infer that the fires must have been the hottest and longest continued, and the utmost efforts at mutilation most persistent, toward this Obelisk and its mate, on which the cartouches of these Pharaohs, constantly repeated and glittering with gold, caught the Persian eye. Such fires would be specially kindled and fed on the two prominent faces of our Obelisk, above designated. The lesser injury to the Obelisk of Usertesen, before the pylon, is thus explained, reaching merely for a few yards above its base.

What evidences of such violence, then, still remain upon our own Obelisk?

(1). The strange condition of the pedestal. It has probably resulted from the envelopment of the bases of nearly all the obelisks, in Upper Egypt, by sand, as at Luxor and Karnak at Thebes, and, in Lower Egypt, by mud from the overflow of the Nile, that but little is known in regard to their pedestals.

At Luxor, the excavation of the bases of both the obelisks of Rameses II, which preceded the removal, by the French engineer,<sup>1</sup> of the western obelisk to Paris, revealed, beneath each shaft, an elaborately sculptured granite pedestal, resting upon a platform of three blocks of sandstone. The monolithic pedestal (see figure in my paper, *Misfortunes of an Obelisk*, loc. cit., page 90), which originally stood under the western obelisk and was left behind by the French, was decorated with figures of pairs of cynocephali or apes (representing the god of wisdom, Thoth) on two opposite sides, and, on its face, with figures of the Nile god, Hâp, presenting offerings to Thoth, and with rows of hieroglyphics, once probably filled with gold; this block was 2 6 meters (10 feet) in height.

<sup>1</sup> Lebas, *idem*, 71.

The other pedestal, beneath the eastern obelisk of Luxor, and now buried in sand twenty feet deep, out of sight, was 3.4 meters ( $11\frac{1}{2}$  feet) in height, sculptured and decorated in the same way.

At Karnak, the standing obelisk of Queen Hatasu, the sister of Thothmeses III and his predecessor on the throne, has a low square pedestal, whose sides are covered with rows of hieroglyphs, also probably filled with gold like those on the shaft above.<sup>1</sup>

The Corfe Castle Obelisk, formerly on the Island of Philæ, has a sandstone shaft, 22 feet and  $1\frac{1}{2}$  inches in height; its sandstone pedestal is 5 feet 9 inches in height, and covered with Greek inscriptions of Ptolemy Euergetes II, in part cut in the stone, and in part painted upon it, or, according to Cooper, originally written in letters of gold.<sup>2</sup>

The Obelisk of An, according to Lenormant, stands upon a simple foundation, now buried several feet beneath the Nile silt, consisting of two broad steps or slabs of sandstone, each about 2 feet high;<sup>3</sup> but, on account of its ancient disturbance, we have no certain knowledge concerning its original support.

In regard to the Campensis or Monte Citorio Obelisk, at Rome, which the Romans tried to use as a sun-dial, it was stated in 1803, "there can still be seen at Rome the original pedestal of the horary obelisk overturned on the Campus Martius," and also that there was in the Vatican "a granite base cut with a cavity, probably to receive an obelisk."<sup>4</sup>

Note the singular fact, however, that we find the huge granite pedestal of the New York Obelisk devoid of sculptures, inscriptions, or even polish; its sides approximately even, but with roughened surface; its edges and angles nicked and uneven; its corners greatly rounded off; and many large spots showing internal cracks by their hollow sound, when lightly tapped. Yet the shaft above shows amusing evidences of the struggle of two successors of Thothmeses III on the throne of Egypt, Rameses II and Osarkon I, to find sufficient room on which to record their inscriptions of self-appreciation; while apparently there were over 220 square feet of blank space waiting for glory on the pedestal below. It seems more than a probability that this pedestal, in its original condition at An, was completely covered with hieroglyphs

<sup>1</sup> Lepsius, *Denkmäler*, Plate 24.

<sup>2</sup> Gorringer, *idem*, 139.

<sup>3</sup> Gorringer, *idem*, 123.

<sup>4</sup> Quatremère de Quincy, *De l'Architecture Égyptienne*, 198, 108.



and sculptures, like those which Rameses II had carved upon the pedestals of his fine monoliths at Luxor: that their entire disappearance, succeeded by a roughened surface, points to the violent mutilation and fire of the Persians: and that, at the time of its transfer to Alexandria, the Romans were content to dress the damaged faces somewhat, to an even surface, rather than to cut new figures or hieroglyphs into the hard granite; of their poor work in imitation hieroglyphs, they have left us samples in some of their own obelisks at Rome.

A corroborative fact is found in the pedestal of the fellow-obelisk, which the English left buried in the sand at Alexandria. As this consists of limestone, it seems likely that the original granite pedestal of that shaft at An was found by the Romans so badly injured or destroyed, that they replaced it at Alexandria with a block of the easily hewn and abundant material, limestone, from the quarries beyond the Nile, adjacent to Heliopolis, at Masara or Turra.

(2). The extreme mutilation of the bases of the two shafts (and these only, of all Egyptian obelisks), particularly at their corners. These are so greatly and irregularly rounded off, that Gorringe estimated that not over two-thirds of the area of the bottom of our Obelisk could come into contact with its pedestal. So great is the rounding on the heel of each shaft, that one old writer, in 1738 A.D., describes it as hemispherical, fitting into a corresponding cavity or hollowed-out socket in the pedestal, and states: "but the Basis or Foot may perhaps be the most remarkable Part of these Obelisks, especially if that at Alexandria is to instruct us. . . . They would bear a nearer resemblance to Darts and massive Weapons, thus more expressive of Rays of the Sun."<sup>1</sup>

As Gorringe states, "that marring of the heel, to the extent of breaking off large masses at the corners, cannot be attributed to the present age. The fractures are also too irregular to admit the theory that they were purposely broken off to facilitate the operation of raising the Needle."<sup>2</sup> The mutilation must have occurred before the erection of the Obelisk at Alexandria, since the Romans then found it necessary to introduce their bronze crabs as supports beneath the four corners. According to one author, "one effect of the removal of the obelisks by the Romans was to break off the

<sup>1</sup> Shaw, *op. cit.*, 411. Also Pococke, *op. cit.*, I, 7.

<sup>2</sup> Gorringe, *idem*, 102.

edges at the bottom. . . . During the transportation, a large portion of the edges at the base was very badly damaged."<sup>1</sup> Such rude and clumsy handling, however, is not likely, in view of the known skill of the Roman engineers: their experience twelve years before, according to Strabo, in conveying a pair of obelisks from An to Rome: and the perfect condition of the bases of the Egyptian monoliths now in Rome, and, in fact, that of the delicate pyramidion of this very Obelisk. The mutilation must have occurred at An, and it is significant that it occurs, in both obelisks, in just that part of the shaft which must have been most exposed to the fire. If the obelisks were then overturned, the injury may have been intentionally increased by mechanical violence.

It is also highly probable that the destructive action of fire was aided by dashing cold water upon the heated stone, as far up as it could be thrown from below, a method of destruction of rock well known to all the ancient nations, and commonly used in their mining.

(3). The partial to complete obliteration of a large portion of the inscriptions on all sides of the base of the shaft, with a peculiar smoothing of the surface, up to a height of 10 or 12 feet above the top of the pedestal. The upper limit of this, the so-called "sand-line," running horizontally around the shaft, begins on the N.N.E. side, about half-way between the two lowest rows of cartouches. In addition to the effacement of hieroglyphs, the peculiar even and shining surface should be noted, which is, to a large degree, free from the pitting, often deep, which covers the surface of the shaft above the line. On the E.S.E. and S.S.W. faces, the same rounding of corners and of edges of the hieroglyphs occurs. But on the W.N.W. face, many sharply carved intaglios remain but little injured, near the bottom of the shaft and for a yard above; thence the same rounding and partial effacement of characters extend up to the same line. All these facts point to an ancient destruction of the lower surface of the shaft by some agency which left it covered with smoothly cleaved planes and broken corners, and to a subsequent protection of the smooth surface from the weathering which caused the pitting above the line.

It is known that at least as far back as the visit of the traveller, Paul Lucas, to Alexandria, in 1714 A. D., the shaft was buried in

<sup>1</sup> Moldenke, *idem*, 20, 39.

sand up to the height of 12 feet, and to its action the obliteration of the characters has been attributed by some, the upper limit having been denominated the "sand-line." But envelopment in sand has served usually, in Egypt, as the best protection. Thus it is stated of two of the most ancient obelisks discovered, those of King Entef of the XIth dynasty, over 2400 B. C., "the hieroglyphics in these obelisks were very well preserved, owing to the friendly protection of the sand beneath which they were buried."<sup>1</sup> The same protection of hieroglyphs, on the under side of the fallen obelisk at Alexandria, was noticed at the time of its exhumation in 1801. The same fact may be even more strongly shown in the remarkable preservation of the Greek and Latin inscriptions upon the bronze-crabs, during nineteen centuries, among whose characters, only partly filled with metallic oxides, the keen eye of our American archaeologist fortunately detected the important lost numeral.<sup>2</sup>

The upper line which bounds most of the obliteration seems to me therefore, perhaps, to mark the highest limit of the most intense flames of the fires at An, and more surely the limit of protection of this smoother fire-flaked surface, from much subsequent erosion and pitting by the weather and drifting sands, during its envelopment to that depth.

(4). The belts of obliteration which stretch up the S.S.W. and W.N.W. sides of the shaft, uniting in the cracked W.S.W. corner. This effacement of hieroglyphs has been attributed to several causes.

(a). *The damp climate and sea-breezes<sup>3</sup> of Alexandria* This will be discussed beyond, where it is shown that the side which then faced the Mediterranean is the present E.S.E. side, on which the inscriptions remain in excellent state of preservation.

(b). *The long continued action of the sun.* This view appears at first the more plausible, since it is probable, for reasons already given, that the badly injured W.N.W. and S.S.W. faces did really stand at An for about 1050 years, as they do now, in full exposure to the afternoon sun. But the present N.N.E. side faced the sun afterwards still longer, at Alexandria, for 1891 years, to the W.S.W., and is the best preserved of all the faces. Nor has such injury been noted on any other of the obelisks, constructed of exactly the same granite, which have stood, in the same climate, at An and at

<sup>1</sup> Stuart, Nile Gleanings, 273. Long, idem, 302.

<sup>2</sup> Merriam, loc. cit.

<sup>3</sup> Clark, op. cit., 31.

Thebes, for still longer periods. The present Obelisk of An has remained on its site, only a few rods distant from that of our Obelisk, for at least 700 years longer, since about 2300 B. C., and the condition of its surface may throw light on the present question. In 1743, a traveller reports:<sup>1</sup> "It is discolored by the water to the height of near seven feet. It is well preserved, except that, on the west side, it is scaled away for about fifteen feet high."

In 1755, Capt. Norden states:<sup>2</sup> "I have represented the western side of this obelisk, because it is the best preserved. I should further state that the bottom of the obelisk on the east is almost entirely ruined, to such an extent, that almost no trace of a hieroglyph can be distinguished upon it."

In 1787, Savary remarks:<sup>3</sup> "The obelisk is in good preservation except toward the southwest, where the granite is chipped to a certain height." These travellers show the usual careless designation of the decayed side; Niebuhr found that the sides faced N.N.E., E.S.E., S.S.W., and W.N.W. No evidences of present decay and scaling are on record, after an exposure of 43 centuries.

As to the obelisks at Luxor, erected about 1350 B. C., before the pylon of that Temple, and fronting N.W., Pococke reported:<sup>4</sup> "The hieroglyphics are cut in with a flat bottom, an inch and a half deep; and the granite has perfectly retained its polish, which is the finest I ever saw. . . . They are exceedingly well preserved, except that about half the pyramid of the western obelisk is broke off, and the southwest corner of the eastern one is a little battered for about six feet high." The one still at Luxor, and also that of Queen Hatasu at Karnak, remain renowned for the perfect sharpness and exquisite polish of their hieroglyphs, even on the sides which have faced the afternoon sun, undisturbed, for 32 to 35 centuries.

In regard to the stela of Begig, in the Fayoum, which lies, fallen and broken, about 43 feet in length, erected also by Userthesen I, Pococke observed,<sup>5</sup> that "the obelisk is much decayed all around, for ten feet high, but mostly on the south side; the west side is almost entirely defaced."

(c). *Attrition by the whirling sands of the desert.* On this, a writer remarked, in 1847: "The obelisk that is still erect among the ruins of Alexandria retains much of the freshness, sharpness,

<sup>1</sup> Pococke, *idem*, I, 23.

<sup>2</sup> Norden, *op. cit.*, I, 104.

<sup>3</sup> Savary, *idem*, I, 123.

<sup>4</sup> *Idem*, I, 107.

<sup>5</sup> Long, *idem*, 319.

and high polish of its first execution on its north and east faces; but the minute particles of sand with which the air is charged, in passing over the desert, have entirely defaced its south and west sides, by beating against it during the 1600 years in which it has stood in its present position."<sup>1</sup>

In favor of this view is the fact of the greater injury on the present S.S.W. and W.N.W. sides, those which fronted the Khamseen, which, in Egypt, blows at intervals from the S. and S.W., driving fine sand, though seldom for more than a day in duration.<sup>2</sup>

But, even on these sides of the shaft, the deepest injury is at the upper part of the W.S.W. corner, most out of reach of flying sand, and of a different character from the superficial erosion effected by that agency. It was only during the last few centuries that the obelisks have been exposed to sand at Alexandria, having been previously protected within the wall of the city; while, at An, the sands of the desert have never reached their site.

The excellent condition of the partially sand-enveloped obelisks of Thothmes I and of Hatasu at Karnak, and of Rameses II at Luxor, show how limited is the erosion attributable to this agency, as well as to the heat of the sun, on Syene granite, during long periods.

(d). *Disintegration by nitrous efflorescence.* Injurious action of this origin was noticed in 1809 by Hamilton,<sup>3</sup> on sandstone from the quarries at Hadjar Silsilis: "The rock, in which these quarries have been excavated, is a very uniform, compact granular sandstone, enclosing sometimes ligneous petrifications. It is extremely hard when exposed to a dry climate and a warm sun, but easily softened by rain, so as to be damaged when moist by whatever touches it too rudely. The exterior of those temples which have been built of it preserves a very clear sandy color; but the walls of the inner apartments are blackened by the confined damp, and by the action of the nitre with which the air is impregnated. In these rooms, the surface of the stone is easily detached in thin flakes."

In his study of the Great Temple at Karnak, Mariette-Bey observed, in 1875: "Every year the river penetrates it by infiltration, and, uniting with the saltpetre with which the soil is impreg-

<sup>1</sup> Osburn, *op. cit.*, 49.

<sup>2</sup> Rawlinson, *Hist. Anc. Eg.*, I, 46.

<sup>3</sup> Hamilton, *op. cit.*, 85.

nated, corrodes and eats away the foundations of the monument. The Grand Temple holds itself up, only because it is supported by the soil in which it is plunged. Naturally there is not a temple in Egypt where the fall of walls happens more frequently.”<sup>1</sup>

Elsewhere, he repeats: “For many years the grand Temple of Karnak has been assailed, more than any other Egyptian temple, by the infiltration of the Nile, whose water, saturated with nitre, eats away the sandstone;” and again, “Karnak has found its principal enemy in the nitre that corrodes the base of its walls.”<sup>2</sup>

Dr. Rossiter W. Raymond has also called my attention to the deep disintegration and scaling away which he observed at the bases of the great pillars in this Temple, and which can also be readily distinguished in some photographs. My brother, Rev. Matthew C. Julien, recently in Egypt, informs me that he also observed the same scaling on the vertical walls at the entrance of the Serapœum.

There can be no question of the decay and serious damage which have been caused, in Egypt, as elsewhere, by efflorescent salts, but, in that country, only on porous sandstone, in enclosures whose soil is saturated with these salts in the immediate vicinity of filthy Arab villages, and to a height of but a few feet above the ground, rarely over a yard.

Therefore, although an early description of ancient Alexandria refers to its “battlements decayed and the stones corroded and disfigured by saltpetre,”<sup>3</sup> there is no evidence nor probability of any granite obelisk having suffered exfoliation from this agency.

(e). *Erosive solution by the Nile-waters or Nile-mud.* This theory, often suggested, of attack by the Nile-waters, or by organic acids of the rich black soil of the Land of Cham, I think, has not been supported by observed facts. No such decay surrounds the shaft of the Obelisk of Heliopolis. Its base was found, by the French expedition in 1807, to be buried in the alluvial plain to the depth of 1.88 meters<sup>4</sup> (6 feet, 2 inches), of which Wilkinson found that 5 feet, 10 inches had accumulated during the last 1700 years. The actual rise of the waters was found to have reached 1.52 meters higher (5 feet), but no corresponding band of exfoliation is noted.

Nor have the carved flutings and hieroglyphs suffered in sharpness, on the colossal statue of Rameses II, once erected before the

<sup>1</sup> Karnak, 7.

<sup>2</sup> Monuments of Upper Egypt, 180, 197.

<sup>3</sup> Volney, op. cit., I, 5.

<sup>4</sup> Histoire Naturelle, Texte, I, 407.

Temple of Ptah at Memphis, which has since lain buried in the Nile-mud, face downward, for over twenty centuries, until its recent exhumation near Cairo

Even though we grant, in the absence of proof, that our Obelisk was overturned in the destruction of the Temple at An, about 515 B. C., it seems impossible that five centuries of burial in the soil could have effected the damage we now see upon its faces.

(f). *The burning of the stone by the Persians.* This appears to me the only satisfactory theory to account for the great injury to the S.S.W. and W.N.W. sides of the shaft. The fiercest flames of the Persian fires, naturally kindled at the most prominent W.S.W. angle, seem to have licked up the adjacent faces, and were probably aided by throwing water upon the heated stone. With the flaking away and fall of the lowest of the hated cartouches of Thothmeses and Rameses from those sides, and the blackening of the rest, the Persian vengeance was sated.

A consideration of all these facts has led me back to the old view, which was thus readvanced, some years ago, by Dr. W. C. Prime: "It is hardly to be questioned that this ancient destruction of the surface was due to the fires of Cambyses, before the stone was transferred to Alexandria. It is probable that, when so transferred and erected in front of the Sebastion, the best preserved side was placed in front, facing the sea. That the monolith was once subjected to severe fire, especially affecting the lower part, and more intense on one side, seems very probable."<sup>1</sup> If also overturned and prostrate for five centuries, as some believe,<sup>2</sup> it may have so fallen as to have buried its present N.N.E. and E.S.E. sides, with its summit under the sand, its heel exposed to mutilation, and its present S.S.W. and W.N.W. sides mainly uncovered to the action of the weather, down to the line now marked by the preserved eastern column of hieroglyphs on its present S.S.W. face.

Our conclusion also confirms that of Denon, at his examination of the two obelisks in 1801: "Inspection of the actual condition of these obelisks, and the fractures which existed at the very time when they were erected on this site, prove that they were already fragments at that period, and transported from Memphis or Upper Egypt."<sup>3</sup>

<sup>1</sup> N. Y. Journal of Commerce, Dec. 16, 1889.

<sup>2</sup> Gorringer, *idem*, 72.

<sup>3</sup> Denon, *idem*, I, 33.

### III. ALEXANDRIA.

In the year 12 B. C., the New York Obelisk and that of London were conveyed by the Romans to Alexandria, probably on a float through a canal and down the Nile, and re-erected near the seashore on the New Port, to ornament the approach to the Cæsareum or Sebastion. There is little likelihood that they suffered any injury while in the care of the skilful engineers of a nation so experienced in the handling of architectural materials, a care exemplified by the elaborate bronze crabs devised and introduced under each shaft, to ensure its permanent support and safety.

The substitution, already suggested, of a limestone pedestal for the ruined granite block which probably supported the London Monolith at An, suggests also that the present limestone foundation of our own Obelisk, with its various enclosures and the substratum of sandstone blocks, may not be of the same age as the pedestal and shaft above, but more likely Roman. Limestone has been the easily quarried, abundant, convenient, and cheap building-stone of Lower Egypt, in all ages; and the limestone blocks in the three tiers of the foundation retain a suspiciously new look and wonderfully sharp arrises, to have passed through the fires and mutilation of An.

#### 9. *Position of Obelisk at Alexandria.*

On its new site, it was shaken by at least the two recorded earthquakes of 1301 and August 8, 1303, A.D., one of which was sufficiently violent to hurl down its companion. Later, it shared with the city, but apparently without harm, its varied experiences in insurrection, siege, and sack, and remained in the same place undisturbed until the close of 1879. Frequent references are made to it by passing travellers and visitors, such as Abd-El-Latif, Philo, Sandys, etc.

In 1714, the English traveller, Paul Lucas, found the pedestal completely buried in sand, and even the shaft up to a height of 12 feet. But this sand had evidently blown away in part in 1738, when Shaw<sup>1</sup> states, "the Height of it is found to be fifty (French) Foot, three whereof are buried underground." Again, in 1743, Capt. Norden observed: "This Obelisk of Cleopatra is situated

<sup>1</sup> Shaw, *idem*, 412.



almost in the middle, between the New City and the Little Pharillon. Its pedestal, of which a part is buried, is elevated 20 feet above the level of the sea. Between this monument and the Port runs a thick wall, flanked with a great Tower on either side of the Obelisk; but this wall is in such a ruined state, that its top is almost level with the pedestal of the Obelisk. The inner part of the wall is but ten feet from this monument, and its outer part but four to five steps from the sea."<sup>1</sup>

In 1787, the pedestal seems to have been visible, according to Savary: "Towards the eastern part of the palace are the two obelisks, vulgarly called Cleopatra's needles, of Thebaian stone, and containing numerous hieroglyphics; one is thrown down, broken, and covered with sand; the other still rests on its pedestal."<sup>2</sup>

In 1801, it was remarked by Mayer: "The Obelisk near Alexandria, called Cleopatra's needle, is a block of granite, not quite six feet in diameter at it's base, and near seventy feet high originally; but it's pedestal, and part of it's base, are buried in the sand."<sup>3</sup>

Again, in 1843, Cooley represented<sup>4</sup> the base of the Obelisk free from sand, but its pedestal still buried, standing in a pit from which the sand had been dug out, for examination by the visitor.

On old maps, the position of the two monuments is commonly marked by two little squares, whose sides on Pococke's "Plan of Alexandria" face about N.W.,<sup>5</sup> but, on most maps, are placed parallel to the shore, which here runs about E.N.E., *i. e.*, they front about N.N.W.

In the more elaborate and faithful drawings of the many represented in plates, in early works of travel, I have made a careful examination of the hieroglyphs, and of the cartouches, whose position and number differ greatly on the different sides of the shaft; also in many photographs, taken at Alexandria at various periods, which show clearly the inscriptions and the well-marked nick, which, as already explained, was probably directed nearly to N.N.W., as the Obelisk stood at An.

[Here the following drawings and photographs were exhibited by lantern projection: View of Alexandria from the sea, in 1755, showing the erect obelisk and remnant of the wall: Views of the Obelisk in 1755, showing the present E.S.E. side, then facing the

<sup>1</sup> Norden, *idem*, I, 5.

<sup>3</sup> Mayer, *op. cit.*, 29.

<sup>5</sup> Pococke, *idem*, I, 2.

<sup>2</sup> Savary, *idem*, I, 36.

<sup>4</sup> Cooley, *op. cit.*, 155.

N.N.W.: Views of Obelisk in 1801, with truncated apex on pyramidion, in 1830, and in 1842, with the sand dug away from pedestal: Photographs in 1870 and about 1880, showing the "nick" directed landward: Views of the fallen obelisk in 1755, and the present London Obelisk, with fractured edges and pyramidion.]

All these plainly and certainly show that, in the position of the shaft at Alexandria, this nick was directed toward the S.S.W.

In other words, when the Romans re-erected the shaft at Alexandria, they placed it before the new Temple of the Cæsars, fronting the sea and the water-gate, *i. e.*, toward the N.N.W.; and moreover, turned the shaft about half round from its original orientation, so that its two best preserved sides would meet the view of the visitor, on his approach to the Temple from the north. The two burned and mutilated sides were turned to the S.S.E. (toward the Temple) and to the E.N.E. The same position, and probably a similar rotation, were carried out in the re-erection of the companion monolith, now at London.

The view above expressed, however, does not agree with that of Gorringe. In Plate XI of his work, evidently prepared in very careful detail, he gives a plan of the pedestal and steps of the foundation, as they stood at Alexandria, with the angles marked N., S., E., and W., each with an arrow, as if to impress its exactness. On the opposite page (18) he also refers to the "S.E. face of the structure" and the "S.W. face." Nor does he make any reference to the change and rotation in the position of the faces of the shaft above.

#### 10. *Condition of the Obelisks at Alexandria.*

We may now report some of the testimony of travellers in regard to the condition of the surface of these monoliths and their theories to account for the injury observed.

In 1738, Shaw related: "But the Alexandrian Obelisk, lying nearer the Sea, and in a moister Situation, hath suffered very much, especially upon that Side which faceth the Northward; for the Planes of these Pillars, no less than those of the Pyramids, seem to have been designed to regard the four Quarters of the World."<sup>1</sup>

In 1740, a Danish gentleman in the squadron of Admiral Haddock, reported thus<sup>2</sup> in Florence: "The hieroglyphs on two adja-

<sup>1</sup> Shaw, *idem*, 412.

<sup>2</sup> Norden, *idem*, I, f.

cent sides (the W. and the N.) are of great beauty; but the others (on the E. and S.) have been much injured by wind and damp; that is why I have represented them exactly as they occur."

In 1743, Capt. Norden observed: "There are only two of the faces which are well preserved; the two others are defaced, and the hieroglyphs can hardly be seen by which they were anciently covered. . . . The injury and effacement on two sides of a stone of such hardness enable us to understand the great difference between the climate of Alexandria and that of all the rest of Egypt; for it has neither been fire nor the hand of violence which has injured these stones. It is clearly evident that it has been only the injury of Time which has eaten away some of the characters and has effaced others, although incised to considerable depth."<sup>1</sup>

In the work of Mayer in 1801, it was remarked: "The sides facing the N.W. and S.W. are best preserved, the hieroglyphics on the other two sides being greatly defaced, especially toward the lower part, large scales falling from the stone, notwithstanding its hardness."<sup>2</sup>

Lenormant, in 1841, concluded: "The obelisk, which has remained erect, has suffered greatly from the saline and corrosive dampness of the sea, principally on the N. and W. faces which front the Mediterranean; that which lies overturned is perhaps still more worn than the other."<sup>3</sup>

In 1842, Lepsius observed: "The two obelisks, of which the one still standing is called Cleopatra's Needle, are very much destroyed on the sides which are exposed to the weather, and in part have become totally illegible."<sup>4</sup>

It was remarked by Long: "Only two of the faces are in a state of good preservation; the other two, the E. and S. sides, being so much damaged by the moist atmosphere of Alexandria, that one can hardly see the sculptures on them. The S. side has suffered most of all."<sup>5</sup>

In 1864, Clark observed that these obelisks were "sadly out of place amid the poverty and dampness of a sea-town. One of these is fallen, and the other is wasting away in the unfriendly air."<sup>6</sup>

In these quotations several careless references occur in naming the sides, as those of the N.N.W. and W.S.W. (usually called the

<sup>1</sup> Norden, *idem*, I, 7.

<sup>3</sup> Lenormant, *idem*, 47.

<sup>5</sup> Long, *idem*, 302.

<sup>2</sup> Mayer, *idem*, 29.

<sup>4</sup> Lepsius, *Letters from Egypt*, 42.

<sup>6</sup> Clark, *idem*, 31.

N. and W., or the N.W. and S.W.) were the ones in good preservation, and those of the E.N.E. and S.S.E. (usually called the E. and S.) were the ones badly decayed.

As to the fallen (London) obelisk, whose base or pedestal probably still lies a few yards S.W. of the former site of the New York Obelisk, two of its sides, ordinarily designated as fronting N. and W.<sup>1</sup> at Alexandria, exhibit very good hieroglyphs, but its heel and edges are battered.

Cooper also states: "The apex is roughly cut and damaged, having been covered, like most of the obelisks of Thothmes III, with a bronze cap. . . . The base of the monument and its two steps or gradués remain entire; they are of limestone and are nearly seven feet high. . . . Owing to the position in which it fell, the monolith has been much exposed to injury, alike from the friction of the sand and the corrosive action of the salts in the sea-breezes; indeed, the S. side has suffered most of all, the hieroglyphics being in many places wholly illegible; the E. face has also suffered severely; the W. face and that which rests upon the ground have been better preserved."<sup>2</sup> The following statement in regard to the surface of the under side of this obelisk, in 1801, after five centuries' partial burial in the sand, implies that the influence of this material, even so near the seashore, has been for protection rather than corrosion: "The Needle was likewise turned over, and the hieroglyphics, on the side it had so long lain on, found fresh and entire."<sup>3</sup>

It will be readily seen, on reviewing these opinions, that there is no agreement as to which were the faces of our Obelisk on which the hieroglyphs were damaged. So unquestionable were the two facts, the mysterious but serious effacement of hieroglyphs on two sides and the great difference of climate in the new home of the Obelisk, that the passing traveller was often unable to accept the evidence of his own eyes. However, it is equally beyond question that it was the present E.S.E. and N.N.E. sides of our Obelisk and the corresponding sides of its London fellow which bore the brunt of attack by the sea-winds at Alexandria for nineteen centuries, and that these are in excellent condition. The injury to the other two sides must then have preceded the Roman transfer of the monoliths from An.

<sup>1</sup> Gorringe, *idem*, 97, 108.

<sup>2</sup> Cooper, *idem*, 125.

<sup>3</sup> *Bombay Courier*, June 9, 1802.

11. *Climate of Alexandria.*

As the unanimous conclusion of the authors just quoted was to attribute the decayed condition of the surface of the obelisks to the damp and saline atmosphere of Alexandria, it is pertinent to consider here some notes on the climate of that city, in comparison with that of Upper Egypt. M. Gratien-Le-Père, Chief-Engineer of the Corps Royal des Ponts et Chaussées, in the French Expedition to Egypt in 1801, states: "The climate of Alexandria is quite healthy; although very warm in summer, this is tempered by the coolness of the nights. The dews of evening, especially in the season of the Etesian winds, are here, as in the entire maritime border of Egypt, of a saline dampness which penetrates all bodies. Winter is very rainy at Alexandria."<sup>1</sup>

Viscount Valentia, in 1802, observed: "The climate is by no means unpleasant, as the heat is tempered in summer by the strong gales, which almost constantly blow from the north, and carry with them the thick black clouds, that, after breaking on the mountains of the interior of Africa, return in the floods of the Nile to fertilize the plains of Egypt."<sup>2</sup>

In Southern Egypt, during the summer (April to October), the temperature varies during the day from 100° to 112° F. in the shade; in Northern Egypt it is cooler. The minimum rarely falls below 40° F. In the French Expedition, the observers noted a minimum of 36½° F., in January, 1799; the average during the night was 46° F. In 1874, a minimum temperature of 23° F. was observed by Rohlf in the Libyan desert. In the Upper Nile valley, showers ordinarily fall only on about 5 or 6 days in the year; heavy rains are rare, occurring about once in 15 or 20 years. It is commonly stated that frost and snow are wholly unknown in Egypt; yet it is recorded that frost has been seen at Cairo,<sup>3</sup> and in the Algerian desert, in latitude but a few degrees further north, snow fell in the year 1847.

At Alexandria, "rain is as common in winter as it is in the south of Europe. But during the rest of the year, as little falls as in the upper country; and at 50 or 60 miles from the coast, the winter rains cease, the climate of Cairo being no less dry than that of the Thebaid."<sup>4</sup>

<sup>1</sup> Gratien-Le-Père, *op. cit.*, III, 279.

<sup>2</sup> Valentia, *op. cit.*, 466.

<sup>3</sup> Foissac, *op. cit.*, II, 263.

<sup>4</sup> Rawlinson, *Hist. Anc. Egypt*, I, 43.

"The general height of the thermometer in the depth of winter in Lower Egypt, in the afternoon and in the shade, is from  $50^{\circ}$  to  $60^{\circ}$ ; in the hottest season, it is from  $90^{\circ}$  to  $100^{\circ}$ , and about  $10^{\circ}$  higher in the southern parts of Upper Egypt."<sup>1</sup>

"On the coast of the Mediterranean rain is frequent, but, in other parts of Egypt, very unusual. At Cairo, there is generally one heavy storm in the winter, and a shower or two besides. . . . At Thebes, a storm occurs but once in about four years, and light rain almost as rarely. The wind most frequently blows from the N.W., N., or N.E., but particularly from the first direction. . . . The southerly winds are often very violent, and, in the spring and summer, especially in April and May, hot sand-winds sometimes blow from the south, greatly raising the temperature."<sup>2</sup>

A recent traveller<sup>3</sup> states concerning the rainfall between February 1 and April 15, 1889: "My first experience in Egypt was calculated to give the impression that it is a rainy country, for I saw two showers in three days. In passing through the Suez Canal (January 31st), a heavy shower, lasting half an hour, drove the passengers to shelter, and a brilliant rainbow delighted beholders. Two days later, rain again fell at night in Cairo, making the dirty streets more nasty still. Of course this experience was exceptional, as rain is a rarity in Cairo. Authorities give the rainfall at Alexandria as about 8 inches per annum, and at Cairo about 1.2 inches; while in Upper Egypt the precipitation of moisture is far less; there are adults living there who say they have never seen rain.

I noticed, on the other hand, unmistakable signs of recent rains, such as dried mud-puddles, raindrop-prints, etc., at several points near Cairo, east of Thebes (Wadi Bab-el-Molook), and in the peninsula of Sinai, and I was impressed with the belief that more rain falls in Egypt than is usually supposed. A local shower, passing over a sandy gravelly region, makes but little impress on it; and there is no corps of trained observers, outside of Cairo and Alexandria, to record the phenomenon. . . . On February 16th I visited a wild valley west of Thebes, known as Wadi Bab-el-Molook. . . . The valley throughout shows that water has at some time been energetically at work; the floor resembles a dried-up mountain

<sup>1</sup> Lane, *Modern Egyptians*, Introd.

<sup>2</sup> R. S. Poole, *Encyc. Brit.*, VII, 703.

<sup>3</sup> Bolton, *loc. cit.*, 113, 117, 118.

torrent; banks of gravel, sand, and boulders rise several feet above the bridle-path on each side; and, at the lowest part, small channels wind about the large rocks. The hillsides are furrowed by ravines excavated by water. Here and there, in low places, usually at the foot of a large boulder, are unmistakable signs of recently formed mud. The scales and mud-cracks were quite fresh, and seemed to indicate that water had accumulated in pools not more than two or three weeks before. On my return to Luxor, I was informed that rain had fallen about three weeks before (February 16th)."

In a discussion of the heavy dews in Egypt, Volney states: "These dews as well as the rains are more copious towards the sea, and less considerable in proportion to their distance from it; but differ from them by being more abundant in summer than in winter. At Alexandria, after sunset in the month of April, clothes exposed to the air and the terraces are soaked with them, as if it had rained."<sup>1</sup>

All these facts, therefore, bear out the idea of the moist character of the climate at Alexandria.

## 12. *Removal of the Obelisk from Alexandria.*

The details of the great enterprise of the lowering of the huge monolith at Alexandria, in 1879, and of its conveyance to New York, have been fully set forth by the engineer in charge, the late Commander H. H. Gorringe. It will be sufficient here to refer only to certain points which might be considered to have some bearing on possible strain or injury to the monument in transit. On October 29, 1879, the work of excavation began, and the bottom of the lowest step of the foundation was found to lie nearly at mean sea-level. This indicated a probable subsidence of the coast of about 17 feet in 1900 years, attended with a decided and increasing inclination of the top of the shaft toward the sea, which must have soon resulted in its fall.

The sides of the lower part of the shaft (as illustrated by a photograph of the bottom of the W.S.W. side, taken at the time of the removal of the London Obelisk) showed the same effaced hieroglyphs, rounded corners, and peculiar smoothed surface as now seen.

Gorringe states that in turning the Obelisk, its bottom bound against the top of one of the crabs, and "removing the crabs was

<sup>1</sup> Volney, *idem*, I, 56.

very difficult, by the lead which had been poured into the mortices in the pedestal while molten."<sup>1</sup> From this it may be inferred that he found the crabs attached only to the pedestal.

In December, 1879, while the shaft, carefully sheathed in heavy plank, was being turned on enormous trunnions, supported on steel towers, a little accident occurred, which he has thus described:<sup>2</sup> "Immediately following a creak louder than any previous one, the motion was suddenly arrested; then there was a sharp snap—one of the tackles had parted. Instantly the order was given to slack the other tackle rapidly, using it merely to retard the motion and not to arrest it; but the man attending the fall had lost his wits, and, instead of slackening, he held it fast and it very soon broke. The obelisk was at that moment about half over. It moved slowly at first, and then more and more rapidly, until it struck the stack of timbers, rebounded twice, and came to rest in the position" shown in an illustration. "There was intense excitement; many of the Arabs and Greeks about the grounds had fled precipitously, when the obelisk began to move rapidly; and when it rested on the stack of timber uninjured, there arose a prolonged cheer. . . . The two upper tiers of plank were crushed; aside from this, no loss or injury to any person or anything resulted from the successful accomplishment of the first essential feature of the work of removal."

Later, during the launching of the caisson which enclosed the Obelisk, its safety was endangered in the surf by a rising storm, and Gorringe allowed the caisson to fill, in order to diminish its buoyancy and prevent it from thumping heavily on its ways. The shaft thus remained immersed in salt water for several days.

After the monolith had reached the floating dock, and had been at last safely introduced into the hull of the Steamer "Dessoug," Gorringe states, "to obviate all risk of breaking the Obelisk by the working of the ship, it was placed on a bed of Adriatic white pine, very spongy and soft, and ten feet of the extremities left without support. To prevent it from moving laterally, a system of horizontal, diagonal, and vertical shores were fitted into the hieroglyphs, and driven against stringer-pieces of the steamer's hull."<sup>3</sup> During the voyage of 37 days, some stormy weather was encountered, both in the Mediterranean and the Atlantic. In spite of all

<sup>1</sup> Gorringe, *idem*, 14.

<sup>2</sup> Gorringe, *idem*, 15.

<sup>3</sup> Gorringe, *idem*, 27.



care, it looks probable that certain projecting hieroglyphs may have been subjected to some undesirable degree of strain.

#### IV. NEW YORK.

On its arrival at New York, the pedestal was directly landed upon New York Island, but the shaft was first landed on Staten Island, September, 1880, then towed to the foot of West 96th Street, again landed, and thence dragged around Central Park and re erected on "Graywacke Knoll," January 22, 1881.

##### 13. *Position of the Obelisk at New York.*

The foundation of the monolith was laid upon the outcrop of the vein of endogenous granite, already mentioned. Gorringer states: "The earth having been removed from the top of the Knoll, the surface of the granite was levelled and the cavities filled with cement. A thin layer of this was then laid over the granite, and the foundation was replaced exactly as it had stood in Alexandria, each piece in the same relative position to the others and to the points of the compass."<sup>1</sup>

In Plate XI of the same work, as already explained, he designates these points of the compass, for the angles, as N., E., S., and W. Elsewhere, he refers to the four sides of the shaft, as facing N., S., E., and W., taking those terms from Chabas and Brugsch, who used them, it may be presumed, loosely, in a general way.

On examination with a compass, however, I was surprised to find that the sides do not now face N.  $45^{\circ}$  E. (N.E.), S.  $45^{\circ}$  E. (S.E.), etc., but respectively N.  $27^{\circ}$  E. (nearly N.N.E.), S.  $63^{\circ}$  E. (nearly E.S.E.), etc.

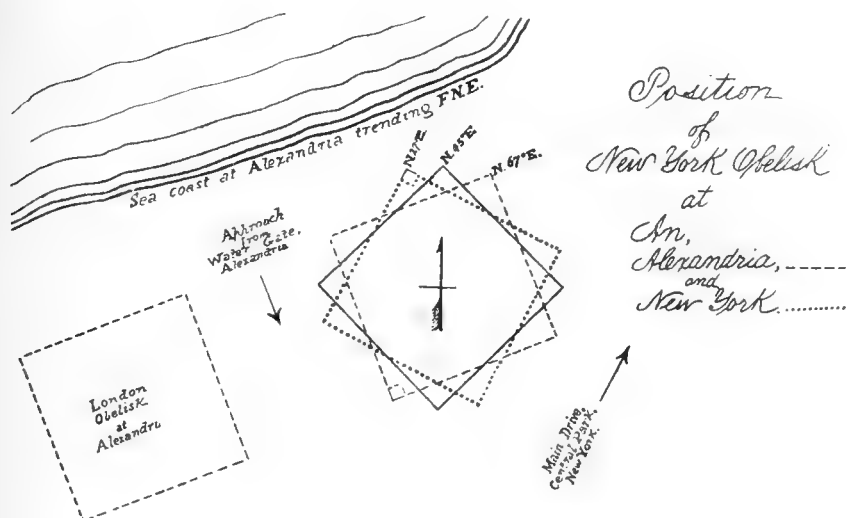
Gorringer's statement refers only to the foundation of the Obelisk, but a reader would naturally infer that the shaft was also replaced here "exactly as it had stood in Alexandria." However, I must call your attention again to the tell-tale nick, now directed to about N.  $18^{\circ}$  W., while at Alexandria it pointed to about S.  $23^{\circ}$  W. It thus appears that, on its re-erection in New York, not only was the whole foundation changed in position from that which it occupied on its Alexandrian site, but that also the shaft was twisted nearly half round to the right: so that both shaft and pedestal now stand once

<sup>1</sup> Gorringer, *idem*, 32.

more in the original position at An. The incorrect statement of Gorringe as to the Alexandrian position of the foundation, and his silence on the readjustment of the shaft, remain without explanation. But in his fortunate accuracy in that readjustment, I can only conjecture that he may possibly have been guided by a knowledge of the true orientation of a surviving companion of our Obelisk, the one still on the site of An: if it shall be found, by more close observation than that recorded by Niebuhr, that this really faces to the present direction of the W.N.W side of the New York Obelisk,  $W. 27^{\circ} N.$

I have plotted, on the accompanying illustration (Fig. 1), the

Fig. 1.



positions which our roving monolith has successively occupied on its three sites, always accompanied, until now, by its London fellow on its left: viz., its positions at An and at New York, by the square with dotted line and nick; its position at Alexandria, by the square with broken line and nick; and, for comparison, its position at Alexandria, according to Gorringe, by the square with continuous line. The interspaces, between the two obelisks and between them and the shore, are contracted in the illustration, for convenience.

It is much to be regretted that a satisfactory explanation of the statement in question has probably been lost by the death of the eminent engineer, in July, 1881, only five months after the completion of his great enterprise, in the successful transfer and re-erection of the Obelisk.

14. *The sudden decay of the surface of the Obelisk.*

In regard to the condition of the surface of the New York Obelisk, immediately after its arrival, there is the following testimony by an experienced geologist,<sup>1</sup> in February, 1883: "The first thing that strikes one is the freshness and soundness of the rock. No 'maladie du granit' is observable, and this fact will answer the first and natural question as to why this rock was so much preferred by the Egyptians for monumental purposes."

On thin sections from the same specimen, Prof. Alfred Stelzner<sup>2</sup> also states, though with some confusion of the products of metamorphism with those of decay: "The microcline . . . is very fresh and free from interpositions. . . . Secondary formations are almost entirely wanting in the sections before me; in only two places appear viridite and 'yellowish green translucent needles of pistazite. The rock of the 'Needle' can therefore be regarded as unusually fresh and 'healthy,' in spite of the honorable age which it possesses."

The specimen, on which these examinations were made, probably formed part of the material cut off, in 1880, from portions of the base of the shaft, by direction of Commander Gorringer, in order to increase its bearing surface on the pedestal and stability, and to facilitate the attachment of the new bronze crabs. About four barrels full of pieces were at that time removed, and are now preserved in the American Museum of Natural History.

Within about a couple of years afterward, the incipient decay of the surface seems to have been first indicated by small pieces of granite, lying around the base, evidently fallen from above. This sudden and strange disintegration was met at first with great incredulity, since it was plainly not due to old age; the monolith had yet seven centuries to catch up with the age of its sturdy old companion, still on the site of An.

In October, 1883, this change was brought to the attention of Dr. F. A. P. Barnard,<sup>3</sup> who found "the surface of the stone step, immediately below the plinth, sparsely strewn with minute fragments of the rock," carefully swept them off, collected and weighed them, to the amount of 24.56 grams (about  $\frac{7}{8}$  of an ounce). From this he calculated the waste per square meter of the surface of the

<sup>1</sup> Frazer, loc. cit., 364; Gorringer, op. cit., 161.

<sup>2</sup> Frazer, loc. cit., 372-374; Gorringer, op. cit., 166-167.

<sup>3</sup> Evening Post, New York, Oct. 30, 1883.

monument per annum to be 0.457 gram, or, from the entire wasting surface, 10.88 grams; and estimated that if "the mass of fragments actually collected was not more than a tenth part of what had fallen during the time the Obelisk has been in our Park, it would still require 6000 years to reduce its volume to the depth of one centimeter on each side."

During the next year, 1884, the progress of the decay became still more manifest by the flaking away and fall of fragments, sometimes of considerable size. Commander Gorringe could hardly believe that they came from the monolith, and expressed the hope that some day it would be polished.

In the autumn of the same year, the attention of the Park Commissioners was directed to this serious decay, and they finally decided to make use of a waterproofing process, founded on the application of melted paraffin to the artificially warmed surface of the stone. This was begun on September 25, 1885, after the Obelisk had stood, entirely unprotected from the elements, for 4 years and 8 months after its re-erection.

In the notes of another observer,<sup>1</sup> made at this time, on the weathered exterior of the Obelisk, it is stated: "Most of the fractures of the flakes seemed of recent origin, although under most of them was found a green vegetable growth of unicellular plants. However, beneath some pieces, the accumulated black dirt showed the fractures to be of more remote origin. . . . Placing a fragment of the rock under the microscope, portions of it show decided disintegration, parts of the hornblende being broken down and dissolved, while some of the white feldspar is broken into such minute fragments that they exhibit the Brownian movement when placed in water. In the minute crevices can be seen the green cells of vegetable growth, and, on either side of the crevice, may sometimes be seen, with the microscope, the rosy hue indicating internal strains in the very minute fragments, a slight increase of which would complete the fracture; and it is possible that the growing cells may furnish the necessary strain." All these vegetable cells were green, some rod-shaped, others round like those of *Protococcus pluvialis*.

On the S.S.W. side of the shaft, where the decay was most pronounced, some of the adhering flakes of rock were found to be parted above from the shaft as much as one-quarter of an inch, a crevice of that width being sometimes found filled with moss and black earth.

<sup>1</sup> Dudley, loc. cit., 67.

In regard to the *Protococcus*, I may reply that its superficial adherence to stone-work is of common occurrence in this country as abroad; and, though often considered unsightly, its presence has never been connected with the decay of stone. The naturalist familiar with its delicate isolated cells will need proof of their ability to produce internal strains in the crevices where they find refuge.

In the preliminary cleaning of the surface, before the waterproofing process was begun, it was discovered that very many spots were in a deplorably decayed condition, especially on the S.S.W. and W.N.W. sides of the shaft. Some large pieces were so loosely attached that they would scarcely bear the hand upon them without falling away. One large slab on the E.S.E. face, with the hieroglyphic symbol of the sun in its centre, actually dropped off in the grasp of a person who laid his hand upon it, to steady himself, while walking by upon the scaffold. This piece was left below, stolen over night and never recovered. No attempt was made to harden or recement this crumbling surface, but it was decided to remove only the looser flakes, most likely to fall, and then apply the preservative. In the course of this removal, one fragment, showing hieroglyphs, was separated from the upper part of the W.S.W. corner of the shaft, which measured  $18\frac{3}{4}$  inches in length,  $3\frac{1}{2}$  inches in width, and  $\frac{3}{4}$  of an inch in thickness; but most of the scales were small pieces, often cracked and ready to crumble. In all, about  $2\frac{1}{2}$  barrels of pieces were removed, found by the Park Superintendent to weigh 780 pounds; of these, three-quarters or more came from the S.S.W. and W.N.W. faces of the shaft. In regard to the great error of judgment shown in the above action, I have elsewhere<sup>1</sup> expressed the universal public opinion.

#### 15. *The waterproofing treatment of the Obelisk.*

The entire surface of the Obelisk was then warmed,<sup>2</sup> in successive portions, by the application of a square pan of burning charcoal, with front of wire grating, for two or three minutes, at a distance of about one inch. The projections and hollows on the surface were warmed by means of a benzine blast-lamp. Immediately after the warming, the compound of paraffin, containing creasote

<sup>1</sup> Misfortunes of an Obelisk, loc. cit., 132.

<sup>2</sup> Robert M. Caffall, Scientific American, XXI (1886), Supplement, p. 8391; and in paper on "The Preservation of Building Materials by the Application of Paraffin, as recently used upon the Obelisk," Trans. N. Y. Acad. Sci., V (1885), 56-66.

dissolved in turpentine, was applied at its melting-point ( $146^{\circ}$  F.) by means of a brush, and the stone then warmed again until the excess of paraffin was absorbed beneath the surface. The surface treated, on shaft and plinth, amounted to about 220 square yards, and absorbed  $67\frac{3}{4}$  pounds of paraffin, to an estimated depth of half an inch or a little more. An equal surface of brownstone would have taken from 40 to 50 pounds, and of brick from 70 to 110 pounds; so that the great porosity of the weathered coating of the Obelisk is clearly shown. Little difference in the action of different parts of the surface toward the paraffin was noticed, except that the black masses of hornblende were particularly absorbent.

A few months afterwards, Dr. T. Egleston presented views founded on an inspection of the Obelisk and of pieces derived from its decayed surface. In these he observed, under the microscope, deep irregular cavities, near the grains of hornblende, empty or partly occupied by that mineral, and crevices containing the green *Protococcus* referred to by Mr. Dudley. He concluded that disintegration had been long going on and was still in progress in the interior of the stone, not of chemical but purely physical cause, mainly the repeated expansion and contraction produced by the rapid and extreme changes of temperature in this climate. In regard to the waterproofing process applied to the Obelisk, he states:<sup>1</sup> "The method of applying the present protecting coating seems to have been a fatal mistake. Nothing of any account has been dissolved out of the stone; there is therefore nothing to be replaced. If there had been, paraffin in solution would have been one of the best materials to fill them. Granite is not porous; there were, therefore, no cavities to be filled. The stone being full of cracks from natural causes, the heat which was used to cause the paraffin to sink into the body of the stone, when applied to the outside, would cause an expansion, which would not be responded to by the interior of the granite, and the cracks already there would increase in size, and pieces would chip off as they did, and new cracks would be formed in the stone, already weakened by long exposure. . . . Even if the surface was entirely waterproofed, the cold of winter and the heat of summer would act below the surface both of the coating and of the stone, causing the coating to break or fissures through it to occur, so as to let in the moisture, and then both causes would operate together as before."

<sup>1</sup> Egleston, loc. cit., 81.

The crumbling decayed stone from the surface of the Obelisk was very unsatisfactory material from which to determine the condition of the stone beneath, and misled the three observers to quite opposite conclusions concerning the decay: Dr. Barnard, to disbelieve in its extent and progress: Mr. Dudley, to connect it with strains produced by the cells of *Protococcus*; and Dr. Egleston, to attribute it mainly to temperature-variations in our own climate. However, the slight plant-growth was doubtless merely accessory. It will be shown beyond that granite is really porous, and its cavities occupied by a substance, moisture, which must be displaced for the proper introduction of any preservative: that this is too powerful a stone to be injured by gentle warming: and that oscillations of temperature had nothing to do with the sudden disintegration of the surface of the Obelisk in 1882-1885.

In regard to this mooted and important question—the effect of moderate elevations of temperature on granite, I have next to present, first, the results of a series of experiments on the application of artificial heat to various building-stones and to the granite of Syene: secondly, some comparative statistics, reduced and tabulated, from meteorological reports on thermometric oscillations in Egypt and New York.

#### 16. *Experiments on granite with artificial heat.*

In view of objections taken against the application of heat to granite, as used in the process of waterproofing the Obelisk in 1885, I have made sundry experiments to determine the degree of heat then used and the exact periods of time during which it was applied, repeating exactly the same process with the same apparatus and workmen.

On testing with a thermometer the melted paraffin compound in the "U. S. pot" used in the process, it was found, if the paraffin was allowed to become entirely fluid, that its temperature rose to  $70^{\circ}$  to  $75^{\circ}$  C. But when, as always occurred during work, a cake of solid paraffin was kept floating in the liquid, the temperature varied from  $59^{\circ}$  to  $67^{\circ}$  C., closely approximating  $63^{\circ}$  C. ( $146^{\circ}$  F.).

During the autumn of 1889, the ordinary waterproofing of stone buildings near New York City was carefully studied. On a cold day, at Orange, N. J., I carefully watched the application of the process to surfaces of Nova Scotia sandstone, in a state of incipient decay, to ascertain the periods during which the stone surfaces

were heated, the melted paraffin applied, and the stone reheated. A condensed statement of the observations is here presented.

| Experi-<br>ment. | Surface treated.                                | No. of<br>observa-<br>tions. | Periods (in seconds). |                   |                    |        |
|------------------|---|------------------------------|-----------------------|-------------------|--------------------|--------|
|                  |   |                              | First<br>heating.     | Paraffin-<br>ing. | Second<br>heating. | Total. |
| 1                | Stone chimney . . . .                           | 3                            | 29                    | 21                | 18                 | 68     |
| 2                | Decayed brick wall . .                          | 5                            | 78                    | 17                | 34                 |        |
| 3                | Stone jambs and mullions<br>of a window . . . . | 3                            | 21                    | 17                | 17                 | 55     |
| 4                | The same . . . . .                              | 5                            |                       |                   |                    | 45     |
| 5                | The same . . . . .                              | 4                            |                       |                   |                    | 65     |
| 6                | Brick wall . . . . .                            | 7                            | 28                    | 21                |                    |        |

The temperature of the air was 6° C. (43° F.), which happens to be about that which prevailed during the waterproofing treatment of the Obelisk in 1885. In the treatment of Nos. 1, 2, and 6, the charcoal-stove was applied, at a distance of 1 to 3 inches from the surface; in that of Nos. 3, 4, and 5, the benzine blast-lamp, over a surface of about 40 square inches. During the heating, a few sandy particles fell from the decayed and softened surface. From the totals, it appears that the entire treatment of a stone-surface, as observed with several workmen, was completed, on the average, in 58 seconds.

These results served as a basis for arrangement of a series of experiments, carried on some weeks later, with the same process and apparatus, in the north court of the old building of Columbia College, at 50th Street, New York City. The treatment was applied in the usual way to various surfaces of old brickwork, covered with hard and dry cement-stucco. In each experiment a thermometer was so inserted, beneath the stucco, that its bulb lay at the depth of 3 mm. ( $\frac{1}{8}$  inch) below the heated surface; the object was to determine the rise in temperature of the superficial layer of cement. Temperature of the air, 15°.5 C.

| Ex-<br>peri-<br>ment. | Original tem-<br>perature<br>of<br>cement. | Source of<br>heat. | First heating.          |                           | Paraffining. |       | Reheating. |       | Total<br>period. |
|-----------------------|--|--------------------|-------------------------|---------------------------|--------------|-------|------------|-------|------------------|
|                       |  |                    | Period (in<br>seconds). | Resulting<br>temperature. | Period.      | Temp. | Period.    | Temp. |                  |
| 7                     | 12.°                                       | Blast-lamp.        | 85                      |                           | 35           |       | 25         |       | 145              |
| 8                     | 13°.5                                      | Blast-lamp.        | 55                      | 24° to 34° C.             | 35           | 39°.7 | 25         | 40°   | 115              |
| 9                     |  | Stove.             | 135                     |                           | 35           |       | 35         |       | 205              |
| 10                    | 17°.5                                      | Stove.             | 50                      | 34°                       | 30           |       | 20         | 42°.5 | 100              |



It was apparent that the temperatures recorded by the thermometer only indicated the inferior conduction of heat by the layer of cement. Other tests satisfied me that, with a layer of compact stone like granite, the final temperature in each experiment would have risen at least  $20^{\circ}$  higher than those above observed.

In order to determine the surface-temperature attained during the heating, the treatment was then applied to a series of dressed cubes of various building-stones, one inch square, imbedded in square cavities, one inch deep, cut in the surface of the cement, so that the outer faces of the cubes in each group lay in the same plane with the surface of the cement. At the end of the second heating, the bulb of a thermometer was instantly applied to the surface of the cubes and covered with felt to prevent radiation.

| Experiment. | Source of heat. | First heating: Period. | Paraffining: period. | Second heating: period. | Total period (in seconds). | Final temperature. | Kind of stone.            |
|-------------|-----------------|------------------------|----------------------|-------------------------|----------------------------|--------------------|---------------------------|
| 11          | Stove.          | 85                     | 35                   | 15                      | 135                        | $42^{\circ}.1$ C.  | Dark sandstones.          |
| 12          | Stove.          | 95                     | 27                   | 30                      | 152                        | $64^{\circ}.7$     | Granites and marbles.     |
| 13          | Stove.          | 112                    | 38                   | 0                       | 150                        | $51^{\circ}.6$     | Limestones.               |
| 14          | Stove.          | 94                     | 22                   | 24                      | 140                        | $62^{\circ}.7$     | Light-colored sandstones. |
| 15          | Blast-lamp.     | 49                     | 16                   | 19                      | 84                         | $67^{\circ}.3$     | Granites.                 |
| 16          | Blast-lamp.     | 73                     | 31                   | 13                      | 117                        | $70^{\circ}.1$     | Granites.                 |
| 17          | Blast-lamp.     | 68                     | 34                   | 16                      | 118                        | $69^{\circ}.8$     | Granites.                 |

To the final temperatures found, I saw reason to attach no importance, as they were evidently much diminished by the rapid radiation, before adjustment of thermometer and felt. So both stove and blast-lamp were then each applied directly to the bulb of a thermometer, at a distance of one inch, shifting the source of heat about in the usual way. It was thus found, on repeated trials, that a temperature approaching  $80^{\circ}$  to  $85^{\circ}$  C. ( $185^{\circ}$  F.) was momentarily attained.

From these results we may gather the following as probable conclusions, in regard to the conditions of temperature during the waterproofing treatment of the Obelisk in 1885:—

(a). The period of heating by stove or blast-lamp and by the melted paraffin was probably a little longer than in the regular process, *i. e.*, 2 to 3 minutes (instead of 1).

(b). The temperature of the melted paraffin, as applied, did not exceed  $67^{\circ}$  C. ( $153^{\circ}$  F.), and in general was about  $63^{\circ}$  C. ( $146^{\circ}$  F.).

(c). The surface of the stone was rarely subjected to a higher temperature than  $85^{\circ}$  C. ( $185^{\circ}$  F.), and probably never, when the stove was used.

(d). Only a very thin outer layer of the granite of the Obelisk was heated beyond the melting-point of paraffin,  $60$ – $63^{\circ}$  C. ( $146^{\circ}$  F.), probably between 6 and 12 mm. ( $\frac{1}{4}$  to  $\frac{1}{2}$  inch) in thickness.

Some effort was also made, in these experiments, to ascertain whether the surface of the granite of the Obelisk could have suffered damage from the temperatures ( $60^{\circ}$  to  $85^{\circ}$  C.) and treatment indicated. Among the samples of granite imbedded in the surface of the cement were pieces of the original fresh stone of the Obelisk, each with a polished face set in flush with the general surface. These faces had been previously studied under pocket-lens, and then under a microscope, with magnifying power of 30 diameters. On re-examination, after the conclusion of the treatment, no effect whatever was detected on the surface subjected to the stove; on the other, treated by the blast-lamp, two or three very minute checks or crevices, perhaps a millimeter in depth, seemed to have developed.

On the same question, some information may be derived from the experience of lithologists, in the mode of mounting thin rock-sections for microscopic examination. After having been ground down to transparent pellicles of extreme thinness and delicacy, these are commonly immersed, on a slide, in a drop of partially inspissated and hardened Canada balsam.

In the first experiments on this subject, a drop of balsam on a glass slide was heated upon a mounting-table, usually from 3 to 5 minutes, for the partial evaporation of the excess of turpentine, its natural solvent. At this point, in place of a rock-section, the bulb of a delicate thermometer was inserted into the drop, and a temperature of  $107^{\circ}$  C. ( $220^{\circ}$  F.) was noted.

Again, a quantity of the balsam, about 200 c. c., was slowly evaporated in a shallow tin-pan, over a low flame. The temperature,  $50^{\circ}$  C. during the first half hour, then rose to  $108$ – $110^{\circ}$  C., and so remained for 3 hours; after 7 hours, when the medium had attained the proper viscosity, the temperature fell to  $80^{\circ}$ , and, while cooling and still viscid, to  $60^{\circ}$ .

Since, therefore, the scrupulous needs of the lithologist, in the investigation of intricate structures of rocks and minerals, are not endangered by subjecting a thin rock-section to a temperature of even  $107^{\circ}$  C. for a minute or more: there seems to be no reason to

presume that any injury could have been done to the surface of the Obelisk, in the waterproofing process, by warming at a temperature which rarely approached  $85^{\circ}$  C., during a period not exceeding 2 or 3 minutes.

### 17. *Effects of the sun's heat on granite.*

In regard to the action upon granite of high natural temperatures, it should be noted that those of rock surfaces, exposed to the sun during the heats of summer, often rise to  $150^{\circ}$  F. ( $66^{\circ}$  C.) and over, especially if the rock is dark-colored; and that of the sands of African deserts sometimes reaches  $200^{\circ}$  F.

An interesting application of this natural warming of surfaces of stone occurred during the hottest period of August, this last summer (1892), at Sandy Hook, N. J. The casemates of the fortifications are constructed of a dark concrete, in large part composed of fragments of "bluestone" (flagstone from the base of the Catskill Mountains). On account of the porosity of the concrete and its permeability by rain-water, these constructions had been undergoing for some months the same waterproofing treatment with paraffin as that applied to our Obelisk in 1885. On certain hot afternoons, it was found that the surfaces of those bomb-proofs which lay exposed to the sun had already become heated to such a degree that artificial heating could be dispensed with and the melted paraffin directly applied.

It is a question of some interest, in reference to the durability of building-stones used in New York City, to determine how often the direct heat of the sun reaches its maximum in this climate. By a collation of the observations of Mr. Daniel Draper,<sup>1</sup> the Director of the Meteorological Observatory in Central Park, the following table has been prepared, presenting for ten years the maxima in the sun of  $140^{\circ}$  F. or over and of  $146^{\circ}$  F. or over. The latter temperature ( $63^{\circ}$  C.) is that of the melting-point of the particular paraffin referred to above.

<sup>1</sup> Abstract of Registers, 1880 to 1889.

| YEAR.                              | NUMBER OF DAYS ON WHICH MAXIMA IN SUN REACHED OR EXCEEDED: |       |       |      |       |      |        |         |       |       |      |       |        |
|------------------------------------|--|-------|-------|------|-------|------|--------|---------|-------|-------|------|-------|--------|
|                                    | 140° F.  |       |       |      |       |      |        | 146° F. |       |       |      |       |        |
|                                    | May.   | June. | July. | Aug. | Sept. | Oct. | Total. | May.    | June. | July. | Aug. | Sept. | Total. |
| 1880                               | 3  | 6     | 4     | 7    | 5     |      | 25     | 1       |       |       | 3    | 4     | 8      |
| 1881                               |  | 2     | 6     | 15   | 9     | 1    | 33     |         |       | 5     | 2    | 5     | 12     |
| 1882                               |  |       | 2     | 1    | 1     |      | 4      |         |       |       |      |       | 0      |
| 1883                               |  |       | 1     | 1    |       |      | 2      |         |       | 1     |      |       | 1      |
| 1884                               |  | 2     |       | 3    | 5     | 1    | 11     |         |       |       | 1    | 2     | 3      |
| 1885                               |  |       | 11    | 5    | 1     |      | 17     |         |       | 3     | 2    |       | 5      |
| 1886                               |  |       | 6     | 1    | 2     |      | 9      |         |       | 2     |      | 1     | 3      |
| 1887                               |  |       | 2     |      |       |      | 2      |         |       |       |      |       | 0      |
| 1888                               |  |       |       |      |       |      | 0      |         |       |       |      |       | 0      |
| 1889                               |  |       |       |      |       |      | 0      |         |       |       |      |       | 0      |
| Total number of days for ten years |  |       |       |      |       |      | 103    | 32      |       |       |      |       |        |

The extreme maxima reached were 151° F., on September 6, 1880, and 154° F., on September 7, 1881. The hours at which the temperature in the sun reached its maximum are recorded for each day in 1885, 1886, and 1887; from these we may conclude that the maximum continues on an average for about 1½ hours, or perhaps somewhat less. If we assumed that the light colored surface of the granite of the Obelisk reached on these days the same temperature as that indicated by the bulb of the maximum thermometer in the sun, which is not probable, we might infer that the surface of the monolith is occasionally heated to the temperature of 146° to 150° F. for short periods, which amount, on an average, to less than five hours during the whole year.

There is then no foundation for the fear, expressed by some persons, that the paraffin, at that melting-point, may flow or has already flown down from the surface to the base of the monument, under the attack of our summer sun. It is more probable, so far as the heat of the sun may ever cause the surface of the paraffin to melt, that this will recement and solidify, during each summer, the superficial minute cracks produced in the paraffin through contraction by the cold of the preceding winter.

As to the intense heat of the Egyptian sun, there is abundant evidence. Burckhart observed the temperature of the air at Esné at 139° F., and Coutelle, that at Cairo at 127° F., and at Philæ, 129° F.<sup>1</sup> Coutelle records a constant temperature at Philæ, from

<sup>1</sup> Foissac, idem, II, 272.

12 to 3 P.M., at  $107^{\circ}.5$  to  $109^{\circ}.5$  F., on the north and in the shade; in the sun, in open air, up to  $113^{\circ}$  F.; in the sand,  $158^{\circ}$  F.<sup>1</sup> Nouet found, opposite the ruins of Thebes, that a thermometer in the sand, at noon, rose to  $153^{\circ}.5$  F.; in the shade,  $100^{\circ}$ , with light wind from N.W.<sup>2</sup> Also at Philæ, he observed thermometer in the sand at  $153^{\circ}.5$  F., and in the shade,  $109^{\circ}$ . During the removal of the western Luxor Obelisk to Paris, in July, 1836, the engineer in charge, M. A. Lebas, states that the sands burned his feet, the temperature of the air, on one day, remaining for four hours at  $66^{\circ}$  C. ( $151^{\circ}$  F.): a sun which strongly recalled, as he feelingly remarks, "the energetic and fitting expression of Moses in regard to Egypt 'this furnace of fire.'"<sup>3</sup>

Dr. Donald Dalrymple,<sup>4</sup> in 1861, called attention to the considerable diurnal variations of temperature in the climate of Egypt. His series of observations of the temperature of the air, on a Nile boat, during the winter of 1859–1860, showed the following average ranges:—

|                          |                 |                    |                 |
|--------------------------|-----------------|--------------------|-----------------|
| December, 1859 . . . . . | $36^{\circ}$ F. | February . . . . . | $50^{\circ}$ F. |
| January, 1860 . . . . .  | $44^{\circ}$ F. | March . . . . .    | $30^{\circ}$ F. |

He also states that "the minimum never registered within 6 degrees of freezing-point out of doors."

More definite on this point are the meteorological observations of Dr. J. D. Hutcheson,<sup>5</sup> at Thebes, during five months of the coolest season, from November, 1881, to March, 1882, inclusive. During each of these months, the daily maxima in the sun, when reduced from his tables, are found to vary as follows:—

|                          |   |
|--------------------------|---|
| November, 1881 . . . . . | $139^{\circ}$ – $171^{\circ}$ F. ( $59^{\circ}$ – $73^{\circ}$ C.). |
| December . . . . .       | $136^{\circ}$ – $145^{\circ}$ F. ( $58^{\circ}$ – $63^{\circ}$ C.). |
| January, 1882 . . . . .  | $125^{\circ}$ – $139^{\circ}$ F. ( $52^{\circ}$ – $59^{\circ}$ C.). |
| February . . . . .       | $119^{\circ}$ – $143^{\circ}$ F. ( $48^{\circ}$ – $62^{\circ}$ C.). |
| March . . . . .          | $134^{\circ}$ – $155^{\circ}$ F. ( $57^{\circ}$ – $68^{\circ}$ C.). |

These figures show that the maximum heat of the sun must be in Egypt far more intense, continuous, and severe upon stone than in the climate of New York. This surprising conclusion is exactly contrary to the prevailing opinion, frequently expressed, concerning the trying climate of New York, with its supposed extraordinary and sudden ranges in temperature. To these has been mainly attributed<sup>6</sup> the mysterious and sudden destruction which began to affect the surface of our Obelisk, soon after its re-erection in New

<sup>1</sup> Contelle, loc. cit., 334.

<sup>2</sup> Nouet, loc. cit., 341.

<sup>3</sup> Lebas, idem, 60.

<sup>4</sup> Dalrymple, op. cit., 7, 11, 25.

<sup>5</sup> Stuart, Fun. Tent of Eg. Queen, 146.

<sup>6</sup> Egleston, loc. cit.

York (January 22, 1881). As it fortunately happened that the period covered by Hutcheson's observations began in the autumn of that year, it would be interesting to compare the similar observations made by Draper at the same time in this city. As conclusions from averages are also often deceptive, it appears desirable to present the daily observations at both localities. In the following table, I have therefore reduced the daily ranges in temperature during those five months, at each place, in Fahrenheit degrees, between the maximum in the sun and the minimum in the shade.

*Daily Ranges in Temperature (F.) between Maximum in Sun and Minimum in Shade.*

|          | NEW YORK. |      |       |      |      | THEBES. |      |       |      |      |
|----------|-----------|------|-------|------|------|---------|------|-------|------|------|
|          | 1881.     |      | 1882. |      |      | 1881.   |      | 1882. |      |      |
|          | Nov.      | Dec. | Jan.  | Feb. | Mar. | Nov.    | Dec. | Jan.  | Feb. | Mar. |
| 1        | 9         | 26   | 48    | 63   | 13   | 103     | 89   | 89    | 82   | 94   |
| 2        | 13        | 68   | 65    | 64   | 68   | 83      | 85   | 94    | 84   | 92   |
| 3        | 24        | 41   | 61    | 73   | 71   | 93      | 86   | 88    | 79   | 90   |
| 4        | 65        | 12   | 65    | 0    | 66   | 83      | 88   | 87    | 90   | 92   |
| 5        | 68        | 65   | 63    | 75   | 65   | 80      | 90   | 88    | 92   | 93   |
| 6        | 66        | 42   | 10    | 68   | 26   | 76      | 88   | 83    | 88   | 98   |
| 7        | 14        | 17   | 8     | 65   | 71   | 77      | 87   | 77    | 89   | 96   |
| 8        | 18        | 64   | 6     | 68   | 78   | 74      | 83   | 82    | 90   | 94   |
| 9        | 26        | 63   | 52    | 0    | 0    | 77      | 92   | 85    | 89   | 89   |
| 10       | 67        | 74   | 59    | 58   | 68   | 79      | 88   | 83    | 89   | 89   |
| 11       | 72        | 73   | 54    | 68   | 66   | 77      | 88   | 74    | 89   | 92   |
| 12       | 20        | 45   | 57    | 68   | 43   | 77      | 86   | 80    | 90   | 89   |
| 13       | 73        | 54   | 3     | 15   | 71   | 83      | 89   | 81    | 86   | 95   |
| 14       | 66        | 29   | 58    | 63   | 73   | 81      | 94   | 79    | 93   | 90   |
| 15       | 68        | 34   | 54    | 64   | 63   | 84      | 91   | 87    | 96   | 86   |
| 16       | 68        | 74   | 52    | 10   | 59   | 87      | 86   | 88    | 76   | 73   |
| 17       | 73        | 63   | 39    | 78   | 72   | 87      | 87   | 86    | 86   | 89   |
| 18       | 30        | 66   | 20    | 68   | 70   | 86      | 92   | 87    | 93   | 92   |
| 19       | 17        | 51   | 70    | 0    | 75   | 88      | 94   | 84    | 94   | 92   |
| 20       | 65        | 27   | 19    | 75   | 55   | 85      | 85   | 84    | 89   | 85   |
| 21       | 49        | 40   | 8     | 0    | 0    | 86      | 86   | 83    | 88   | 91   |
| 22       | 64        | 10   | 80    | 64   | 60   | 85      | 87   | 80    | 70   | 93   |
| 23       | 20        | 75   | 72    | 71   | 70   | 84      | 89   | 83    | 63   | 85   |
| 24       | 55        | 58   | 61    | 67   | 55   | 84      | 90   | 89    | 72   | 84   |
| 25       | 69        | 57   | 44    | 79   | 69   | 82      | 92   | 83    | 86   | 89   |
| 26       | 68        | 41   | 18    | 62   | 65   | 82      | 92   | 87    | 87   | 87   |
| 27       | 68        | 8    | 62    | 74   | 0    | 81      | 88   | 86    | 86   | 83   |
| 28       | 69        | 0    | 4     | 60   | 69   | 82      | 85   | 83    | 91   | 90   |
| 29       | 67        | 0    | 66    |      | 69   | 85      | 90   | 87    |      | 87   |
| 30       | 76        | 54   | 62    |      | 63   | 87      | 88   | 85    |      | 82   |
| 31       |           | 51   | 7     |      | 66   |         | 88   | 87    |      |      |
| Averages | 51        | 44   | 44    | 54   | 57   | 83      | 88   | 85    | 86   | 87   |

The similar averages, at New York, for the remaining months of 1882, were as follows:—

|                  |                      |                     |
|------------------|----------------------|---------------------|
| April . . . . 49 | July . . . . 60      | October . . . . 30  |
| May . . . . 41   | August . . . . 59    | November . . . . 50 |
| June . . . . 61  | September . . . . 38 | December . . . . 50 |

These figures show that while the changes in the range of temperature at New York are frequent and sudden, and correspondingly trying from the physiological point of view, the actual daily ranges of temperature at Thebes are 60 per cent. greater than those at New York, constant, and proportionately severe in the amount of repeated expansions and contractions of the surface of stone caused by such daily oscillations. The ranges at Thebes do not lose in importance from the fact that they occur somewhat further up the scale than at New York, since the question of frost is a distinct subject for consideration.

A natural conviction as to the severity of our climate, with its intense heats of summer, bitter cold periods during midwinter, and frequent and sudden alternations of rains, snow, and sunshine, thawing and freezing, during spring and autumn, has influenced the popular judgment on the true causes of stone-decay.

The common, and, as I think I have shown, mistaken view, thereon upheld, may have been partly founded on inexact appreciation of the intervals between conspicuous extremes of temperature at New York. Thus, in January, 1882, the observed temperatures varied at one time from 97° F. in the sun to —6° F. in the shade, but with an interval of six days between these extremes, and no greater range than 58° on any one of those days. At Thebes, in the same month, the variation of 94° occurred on a single day (the 2d), viz., from 45° to 139° F.

But the actual ranges of temperature to which the surface of a solid body must have been subjected at Thebes, between the extreme heat of the burning sun by day and the cold produced by radiation toward the cloudless sky of Egypt by night, may be probably better estimated with reference to the minima recorded at night by a thermometer on the grass. From Hutcheson's tables for these minima and for the maxima in the sun, I have deduced the following variations of the daily ranges of temperature during each of the same five months.

|                |   |   |   |   |                           |
|----------------|---|---|---|---|---------------------------|
| November, 1881 | . | . | . | . | 90°–111° F. (50°–62° C.). |
| December       | . | . | . | . | 94°–109° F. (52°–61° C.). |
| January, 1882  | . | . | . | . | 86°–106° F. (48°–59° C.). |
| February       | . | . | . | . | 72°–110° F. (39°–61° C.). |
| March          | . | . | . | . | 76°–117° F. (42°–65° C.). |

It therefore appears that, even during the coolest season at Thebes, the surface of solid bodies must be subjected to daily variations of temperature approaching 72° to 117° F., *i. e.*, about 100° F. every day. Also, from the table of maxima already given, that a surface of stone is daily heated for a time, during eight or nine months of the year, to a temperature at or above that of melting paraffin (146° F.). So far then as concerns mere oscillations in temperature, the climate of Egypt must be far more trying to the surface of stone than that of New York; the Obelisk, since its transfer to New York, has been in much less need of protection from injury by mere variations of heat and cold; and its sudden decay immediately after its arrival here was certainly not due to this agency.

This subject has been here considered and discussed in some detail, on account of the divergence of my conclusion from the common view, and of its practical bearing on the true cause of injury to building-stones, as well as to the Obelisk, to be feared from our climate, and on the proper method for their protection.

We have also invaluable evidence, already presented, as to the slow action of even the burning sun of Egypt, as well as of its extreme diurnal changes of temperature, upon the surface of granite, in the condition of all the obelisks and of their sides which faced the mid-day and afternoon sun (paragraph 8, (4), b), during recorded periods of enormous length.

#### 18. *Waterproofing treatment of other Egyptian obelisks.*

We may here pertinently refer to processes adopted abroad for the protection from the weather of other Egyptian obelisks of the same granite, and to the scanty testimony concerning their results.

(1). *The London Obelisk.*—This monolith, once the fallen companion of our own at Alexandria, reached the Thames, January 20, 1878, and was re-erected on September 12 of the same year. As to its condition on arrival, Prof. Bartlett, of London, has stated in a letter: "Soon after it arrived in the Thames, I was requested to examine its then condition, and to advise a professional friend at



the Metropolitan Board of Works. My report was that the granite had become largely decomposed at the surface, and was more or less undermined by the action of the weather during many centuries; that one face was far more eroded by the attrition of the sand, and perhaps by the chemical action of the Nile water, than were the other three sides. In short, that the granite was precisely in that absorbent state that it would imbibe dampness from our atmosphere, and become liable to exfoliate and throw off scale after scale, under the influence of frost, until but little of the inscriptions would be likely to remain, after one or two of our English winters." As to the preservative soon after applied, Mr. John Dixon, the engineer who conveyed the monolith to London, writes, in a recent letter (May, 1891) to the London Times:—

"My attention has been drawn to some statements in the House of Commons as to the alleged decay of the Egyptian obelisk on the Thames Embankment.

"After making a careful personal examination of the monument, my critical eye fails to detect upon its surface a sign of any decay whatever. Were there such, there could be no doubt there would be grains of the stone lying on the altar steps and top of the pedestal. I climbed up and could not see one sign of any decay. I also could see glittering points on the surface, of the solution of silica supplied to me by the skilled chemists of the British Museum, at the suggestion of my old friends, Sir Richard Owen and Dr. Birch, and of which three coats or washes were given with the greatest care, before the trunnions and fastenings for the final lift were placed around it."

However, it has also been stated,<sup>1</sup> probably in reference to a subsequent treatment, that the same monolith "was treated, in 1879, by Mr. Henry Browning, with a solution of gum dammar dissolved in benzin, to which a small amount of beeswax was added, and a very small quantity of corrosive sublimate."

(2). *The Paris Obelisk*.—After its removal from Luxor to Paris, in 1836, this monolith lay untouched for 22 months, while its pedestal was being quarried from a granite outcrop in the western part of France. After its erection, "as a protection against a climate so much more rigorous than that of its native land, the surface of the obelisk was covered with a concentrated solution of caoutchouc."<sup>2</sup>

<sup>1</sup> Trans. N. Y. Acad. Sci., V (1886), 67, and Gorringer, op. cit., 107.

<sup>2</sup> Gorringer, idem, 92-93.

It has also been stated that several attempts were made to weatherproof this obelisk with the silica treatment.

As to the present condition of this monolith, Prof. Egleston<sup>1</sup> states: "The obelisk in the Place de la Concorde in Paris is reported cracked all over its surface. Both the European obelisks are therefore in danger of being seriously damaged within the next hundred years."

19. *Examination of Obelisk by Committees of Experts.*

On November 30, 1889, the Commissioners of the Public Parks of the city of New York requested the following persons to act as a Committee of Experts, to make an examination of the Obelisk and report to the Board, as soon as practicable, as to its condition, with reference particularly to its preservation, viz., Lt.-Col. G. L. Gillespie, of U. S. Engineers, Profs. J. S. Newberry, Albert H. Gallatin, and R. O. Doremus, Mr. E. E. Farnam, former U. S. Consul General in Egypt, and the author. On May 20, 1890, the Committee reported<sup>2</sup> that they had found the general surface of the Obelisk "in as perfect a state of preservation, apparently, as when it was treated with the paraffin wax compound, over 4 years and 6 months ago," and "in no present need of any additional treatment." They recommended an additional local treatment, by the same process, of certain spots on the monument, which, before 1885, had become more deeply decayed and yet give a hollow sound to a light blow. Of these spots a full individual description was given in an Appendix to the Report, together with a chart of the four faces of the Obelisk, showing their exact location. It was further recommended that the process should be modified for this special purpose, by application of more gentle and longer continued warmth, without the use of the blast-lamp; that no stone should be removed from the surface of the monolith: that a preliminary experiment should be carried on upon a large block of coarse granite, to determine the depth of penetration of the compound into the stone: and that the retreatment of these spots on the Obelisk should take place during the hottest part of the following summer, July or August, when the stone was in its driest state. The recommendation of re-treatment of these spots simply meant that, in view of the deep decay and exfoliation which had occurred up to 1885, the process had been

<sup>1</sup> Loc. cit., 84.

<sup>2</sup> Report, p. 10.

then carried on too rapidly to insure, in such spots, an infiltration of melted paraffin to a sufficient depth for perfect safety.

On June 30, 1890, the Park Commissioners appointed a Second Committee, consisting of the late Prof. John S. Newberry, (Prof. Albert H. Gallatin, who was unable to serve) and the author, to carry out the proposed experiment and define the details of the modified process. On July 24, this Committee sent in their Report. This and the preceding Report (with the exception of its Appendix and chart) have been printed by the Park Department, but only in small number. It is therefore desirable to present here the principal facts, including the more scientific and technical details.

"The object of the experiment was to determine the best conditions for the re-treatment of the decayed spots upon the Obelisk during the coming month of August. . . . It was necessary in the first place to obtain a large block of granite of approximately the same mineral composition and texture as that of the Obelisk, and, if possible, of the same size." After much exploration of the granite yards of New York City to obtain the use of a block of sufficient size, and many inquiries concerning the granite quarries up the Hudson River, in Connecticut, near Saybrook and along the Sound, and in the islands off the coast of Maine, "our attention was directed to the many large transported boulders of granite or coarse granitoid gneiss which are strewn over the surface of Westchester County. In masses of rock like these, exposed to the weather for ages, we might fairly expect to find the better material for which we were looking—that which had experienced an incipient internal decomposition and increased power of absorption, as in the granite of our ancient Obelisk. Near Tuckahoe and New Rochelle several such boulders were found, though of insufficient size, on the lands of Mr. F. Wiede and of Mr. C. Morgan, to whom also our thanks are due for offered assistance.

At last, near the summit of a hill on Midland Avenue, about two and one-half miles southwest of Bronxville, an enormous boulder, nearly twenty feet in height, of granitoid gneiss, was found on the DeWitt property, which seemed well enough suited for our object. Its mineral components were found to be very nearly the same as those of the Obelisk, viz.: white feldspar (triclinic), potash feldspar, quartz, hornblende, biotite-mica, and a little garnet, magnetite, etc. The volume of the entire boulder was measured and ascertained to be nearly three times that of the Obelisk; but it was divided in two

parts by a deep cleft. Our application to Mr. William D. DeWitt for its use met with his ready consent, and whatever help we needed."

In the ensuing experiment, the Committee had two points in view:—

First, "to determine the rate of penetration of a definite amount of heat into a huge mass of granite, when applied continuously to a small spot on one surface." The practical object was to ascertain the time needed to bring the temperature of a layer of the granite, one to two inches in thickness, up to or a little above the melting-point of paraffin, without injury to the stone.

Secondly, to determine the most effective way, and proper apparatus, for the application of melted paraffin, to cause the deepest penetration and thorough saturation of the warmed stone and of any cavities or crevices lying beneath its surface.

(1). *The application of heat.*—The N.E. corner of the huge boulder was selected for the main experiment, where two vertical faces, approximately even and smooth, met nearly at a right angle. The N. face presented, in cross-section, the edges of the vertical laminæ of the gneiss. The E. face was reserved for the application of the heat, and on the N. face, at a point about 6 feet above the ground, a series of 13 horizontal holes, about 2 cm. in diameter, were drilled at right angles to the face, each to the depth of about 10 inches, for the insertion of a set of thermometers in a sloping line. The direction of these holes was controlled by means of an instrument constructed on the principle of parallel rules; by this also the exact distance was ascertained between the bottom of the hole, where the bulb of the thermometer would lie, and a marked spot on the east face of the boulder, 10 inches south of the corner. The holes were arranged in a line sloping upward at an angle of about  $45^{\circ}$ , with the purpose that every thermometer-bulb should lie horizontally behind the warmed spot on the east face of the boulder, and yet without the interposition of any other of the bored holes and interference with heat-waves which might thence result. Into these holes the set of long delicate thermometers, with open Centigrade scale, were inserted and firmly packed with soft asbestos-wool or cotton, so that their bulbs were arranged at the following successive distances from the east face, 1.7, 2.4, 2.8, 3.1, 4, 4.8, 5.6, 6.5, 8.3, 24.6, and 50.1 centimeters: and so that the degrees above  $20^{\circ}$  C. were visible at a glance, upon the projecting parts of the scales, from an observer on a small platform near the corner on the north side.

In front of the east face a shears was erected, supporting the

source of heat, a flat charcoal stove or upright pan, 20 by 14 inches in dimensions, with its face covered by coarse wire-grating, kept filled with charcoal at red heat. This stove was suspended usually at a distance of about 25 inches from the marked spot on the east face. In order to direct and control a uniform heat upon this spot, the stove was partly surrounded by a sheet-iron screen, extending from the stove to the surface of the rock.

The degree of surface temperature was determined by another thermometer, whose bulb lay against the same marked spot. It was controlled by moving the stove occasionally back and forth, when the ignited charcoal varied a little in radiated heat, as on the addition of fresh fuel, so that the temperature should remain at about  $88^{\circ}$  C. ( $190^{\circ}$  F.); it was found to be under easy control, within a few degrees, with the apparatus described. The experiment began at 11 A. M., on Tuesday, July 20, 1890, in charge of both members of the Committee, and continued for  $7\frac{1}{2}$  hours until sunset, the thermometers being constantly observed and noted. The day happened to be very suitable for the experiment, clear and warm, the temperature during the afternoon varying from  $25^{\circ}$  to  $21^{\circ}$  C.; the air was nearly calm, with only now and then a very light breeze, which was continuous after 5 P. M. At any time during the experiment, the observer could without discomfort lay his hand on the warmed surface of the rock, alongside of the thermometer. With constant and careful inspection of the surface, during the heating and at its close, "no evidence whatever was seen of cracking, scaling, or any other injury to the warmed stone" on the east face, or on its section on the north face.

(2). *The application of melted paraffin.*—To the spot on the east surface of the boulder, warmed for  $4\frac{1}{4}$  hours as just described, melted "paraffin, colored red by alkanet root, was applied with a brush for a few minutes, before the sun went down and brought this experiment to an end. The reddened paraffin was found to have penetrated at least 1.7 centimeters ( $\frac{2}{3}$  of an inch), even with so short an application."

"During that experiment, however, another stove was applied in the same way to a neighboring boulder of the same stone, of smaller size, during two hours. To this spot a shallow metal tank was taken quickly and tightly fitted, with its side open against the warmed rock, and filled with the same colored paraffin, kept liquid for one hour longer. The tank was then removed, and, on the next day, the face of the rock was cut off and the depth of penetration

of the paraffin observed on the cross-section. At that part of the face of the rock which had been subjected to the melted paraffin for one hour, it was found that a layer of twenty-five to thirty-two millimeters (one to one and one-quarter inch) had been saturated."<sup>1</sup>

To facilitate observation of the depth of penetration, the melted paraffin had been previously dyed to a deep red color by alkanet root. But the curious fact was observed that, although the color was apparently held in true solution, it was strained out of the paraffin by the outer layer of decayed rock, about 3 millimeters in thickness, and only uncolored paraffin penetrated below. As the latter was easily distinguished, this result was of no practical importance. I presume that it may have been due to a precipitation of the color, as a "lake," by the kaolin or free alumina in the weathered crust of the rock.

The Report concluded with the following five recommendations by the Committee:—

"1. That the comparatively slow penetration of paraffin into the solid granite, after so long an application of heat, confirms the view of the shallowness of the present layer so saturated upon the surface of the Obelisk, as accomplished nearly five years ago by the usual quick process. Therefore the experiments of the present Committee lead us to renew the recommendation of local re-treatment, in order to insure the safety of the cracked and more badly decayed spots. The absence of the least indications of injury to the stone, after four hours' continuous warming, seems to us to show that the process can be used without danger. . . .

"2. That the heat should be applied to each spot in the way and with the apparatus already described, at a distance not less than twenty-four inches, in such a way as to keep a thermometer, with its bulb applied to the warmed surface, at a temperature not exceeding one hundred and ninety degrees Fahrenheit, and for a period of about two hours.

"3. That those decayed spots whose small size (three or four inches), indistinct sound on tapping, and freedom from visible cracks, indicate the probable shallowness of the decayed or loosened flake, shall be then, while still continuously warmed by the stove, repeatedly painted over with melted paraffin, by means of a brush or sponge, for about one-half hour to one hour, until the rejection of the paraffin shows their perfect saturation.

<sup>1</sup> Report, 14.

“4. That those decayed spots whose large area (sometimes reaching a diameter of twenty inches), deeper hollow sound, and display of cracks, indicate the depth of their decay and the possible existence beneath of a cleft or cavity of some size, shall be submitted, immediately after two hours’ warming, to the action of a tank of melted paraffin for about an hour, or until there is evidence of the arrest of absorption of paraffin.

“For this purpose we also recommend the use of tanks of greater height, in order to increase the hydrostatic pressure of the melted paraffin and its consequent penetration into the interstices of the rock.

“5. We particularly recommend the careful treatment, in the latter method, of the large loosened flakes upon the west face of the pyramidion and vicinity, and of the southwest corner of the Obelisk for thirty feet below, and that the cracks be left neatly filled up or ‘pointed’ with solid paraffin.”

20. *Experiment on rate of penetration of heat into granite.*

For the practical end in view in the experiment described, the rough estimate stated was entirely sufficient. But the figures obtained were available for a closer determination of the rate of penetration of the heat-wave, and this has been since calculated and is now presented below.

Before the experiment, the entire set of thermometers, Nos. 1 to 13, were carefully compared, in the part of the scale used (above 20° C.), in warmed solutions at successively increasing temperatures, with a pair of standard thermometers, made by Tonnelot, of Paris, marked Nos. 50 and 52, kindly loaned to me for the purpose by Dr. Charles F. Chandler. In these, the constants had been already determined at the Yale College Observatory. The comparative trials were carried on in the Laboratory of Microbiology of Columbia College, but need not be described in detail. The results of the comparison yielded the following corrections, which have been applied to all the observations recorded beyond.

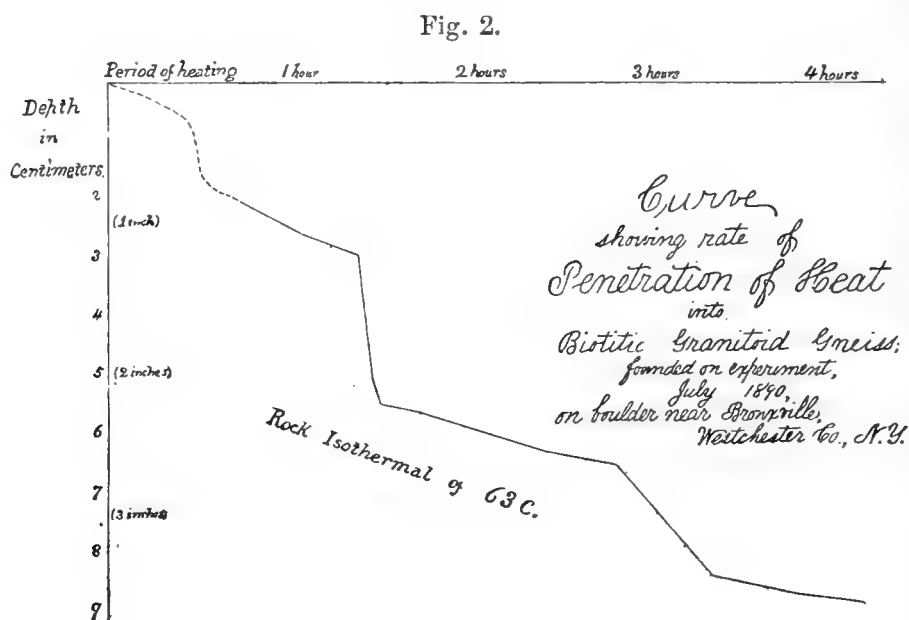
| No. of ther-<br>mometer. } | 1  | 2  | 3  | 4  | 5  | 6  | 7  | 8  | 9  | 10 | 11 | 12 | 13 |
|----------------------------|----|----|----|----|----|----|----|----|----|----|----|----|----|
| Correction . .             | 0. | 0. | 0. | 0. | +7 | 0. | +2 | −2 | −3 | +1 | +1 | −6 | −2 |

In the following table, the corrected figures are given from the observation note-book:

| Time of observation. | Total period of heating (minutes). | Distance of stove from rock (inches). | No. of thermometer. |               |      |                |                |                |      |                |                |                |                |      |      | Distance of bulb from heated surface.   |
|----------------------|------------------------------------|---------------------------------------|---------------------|---------------|------|----------------|----------------|----------------|------|----------------|----------------|----------------|----------------|------|------|---|
|                      |                                    |                                       | 1                   | 2             | 3    | 4              | 5              | 6              | 7    | 8              | 9              | 10             | 11             | 12   | 13   |   |
|                      |                                    |                                       | 0.                  | 1.7           | 2.4  | 2.8            | 3.1            | 4.             | 4.8  | 5.6            | 6.5.           | 8.3            | 8.6            | 24.6 | 50.1 | Centimeters. }<br>Inches. }   |
|                      |                                    |                                       | 0.                  | $\frac{3}{8}$ | 1    | $1\frac{1}{8}$ | $1\frac{1}{2}$ | $1\frac{3}{8}$ | 2.   | $2\frac{1}{4}$ | $2\frac{3}{8}$ | $3\frac{1}{8}$ | $3\frac{1}{2}$ | 10.  | 20.  |   |
| 11.15 A.M.           |                                    |                                       | 25° 2 C.            | 23.           | 24.  | 26.1           | 24.            | 24.            | 24.  | 22.8           | 22.6           | 23.8           |                |      |      | Thermometers allowed to assume temperature of rock during three hours.  |
| 1.55 P.M.            |                                    |                                       | 24.8                | 24.3          | 24.3 | 24.5           | 24.7           | 24.7           | 24.8 | 24.7           | 24.2           | 24.4           | 21.4           | 20.9 |      | In the second line, the slight increase of temperature, at a depth of 2.8 to 6.5 centimeters (thermometers Nos. 4 to 9), apparently indicates the advance of the heat-wave from the surface recently warmed by the morning sun. |
| 2.20                 | 5                                  | 15                                    | 82.                 |               |      |                |                |                |      |                |                |                |                |      |      |   |
| .21                  | 6                                  | 18                                    | 88.                 |               |      |                |                |                |      |                |                |                |                |      |      |   |
| .27                  | 12                                 | 25                                    | 87.5                | 43.           | 36.1 | 36.5           | 30.6           | 32.            |      | 25.3           | 24.4           |                |                |      |      |   |
| .30                  | 15                                 | "                                     |                     | 47.           | 39.6 |                |                |                |      |                |                |                |                |      |      |   |
| .37                  | 22                                 | "                                     | 92.                 | 51.8          | 44.4 | 46.            | 38.3           | 39.5           | 31.9 | 27.2           | 25.8           |                | 21.4           | 21.2 |      |   |
| .45                  | 30                                 | "                                     | 86.5                | 57.9          | 50.9 | 52.8           | 44.9           | 42.8           | 37.6 | 32.6           | 28.8           | 27.7           | 21.4           | 21.4 |      | North side of rock sensibly warm to hand, to depth of No. 3 (1 inch).   |
| .46                  | 31                                 | "                                     |                     | 60.8          |      |                |                |                |      |                |                |                |                |      |      |   |
| 3.                   | 45                                 | 25 $\frac{1}{2}$                      | 88.                 | 66.1          | 59.4 | 60.7           | 51.6           | 53.9           | 47.6 | 46.5           | 39.2           | 35.            | 33.1           |      |      |   |
| .20                  | 65                                 | "                                     | 85.                 | 73.8          | 66.7 | 56.3           | 58.            | 59.7           | 55.3 | 54.5           | 45.5           | 41.3           | 39.1           | 21.8 | 21.6 | Stove now refilled with charcoal, in five minutes.  |
| .40                  | 85                                 | "                                     | 75.5                | 73.7          | 68.  | 67.            | 60.            | 60.9           | 59.2 | 58.4           | 48.9           | 45.3           | 43.2           | 22.3 | 21.8 | North side of rock warm, nearly down to No. 9 (2 $\frac{1}{2}$ inches).   |
| .45                  | 90                                 | "                                     |                     |               |      |                |                |                | 60.4 |                |                |                |                |      |      |   |
| .47                  | 92                                 | "                                     | 81.8                |               |      |                |                |                |      | 60.            |                |                |                |      |      |   |
| 4.                   | 105                                | "                                     | 90.2                | 80.4          | 72.9 | 72.1           | 62.9           | 66.1           | 64.8 | 63.9           | 53.1           | 50.1           | 48.1           | 23.7 | 22.4 |   |
| .43                  | 148                                | 25                                    | 86.4                | 87.5          | 80.3 | 77.5           | 69.            | 72.1           | 73.1 | 72.1           | 59.9           | 57.4           | 55.3           | 24.9 | 22.4 | North side of rock warm to depth of 5 inches. Gentle breeze.  |
| 5.7                  | 172                                | "                                     | 88.5                | 88.7          | 82.7 | 79.3           | 70.8           | 74.            | 76.5 | 75.3           | 63.            | 61.2           | 59.1           | 26.9 | 22.6 | North side warm to depth of 7 inches.   |
| .39                  | 204                                | "                                     | 87.2                | 89.9          | 83.8 | 81.3           | 71.3           | 75.2           | 78.1 | 77.2           | 64.6           | 63.7           | 61.8           | 27.  | 23.4 | Gentle breeze.  |
| 6.6                  | 231                                | "                                     | 66.                 | 85.7          | 81.8 | 78.7           | 71.            | 72.6           | 78.8 | 78.1           | 66.3           | 65.9           | 64.            | 29.6 | 23.5 | Gentle breeze.  |
| .32                  | 257                                | "                                     | 79.                 | 85.3          | 80.4 | 77.7           | 69.9           | 72.            | 77.5 | 76.9           | 65.6           | 65.8           | 64.2           | 30.8 | 22.9 | North side warm to depth of 9 inches. Gentle breeze.  |



From these figures I have plotted the curve (Fig. 2), showing rate of penetration of heat into this stone.



From a consideration of the figures in the table, and this plotted curve, the following conclusions may be drawn:—

(1). That the progress of the heat-wave into the stone is curiously intermittent, with alternations of slow advances and rapid plunges, lessening however in contrast, in proportion to the increasing depth.

As the stone, though gneissoid in structure, is comparatively homogeneous, and the direction of penetration is normal to the lamination-planes, we may reasonably attribute this character of the curve mainly to the moisture locked up, in varying proportions, in the interstices of the successive layers. The increment of heat seems to be repeatedly absorbed, during a period of one-half to one hour, during the vaporization of moisture in a layer of about one centimeter in depth, and its advance thereby delayed. Then the balance of forces is suddenly broken, possibly by a lateral escape of vapor through some crevice, and a rapid advance of the heat-wave ensues during a few minutes, at first to a depth of two or more centimeters. Then comes the resistance of gathering vapor as before.

(2). The determination of the rate of increment of heat, in this experiment, has been affected by several sources of disturbance and variation. The acquirement of exact and uniform figures would involve the prevalence of the following theoretical conditions: the

emission of heat of definite amount, at a constant rate, from a point, through a homogeneous medium; even thus, the rates of increment, at successive points along a radius of the spherical heat-wave projected through the medium, would evidently decrease, at a rapidly augmenting geometrical ratio with the distances from the center. In our experiment, however, the following sources of variation and disturbance must have accompanied these theoretical conditions:—

(a). Irregular distribution of temperature through the rock, before the experiment.

(b). Irregular source of heat: an indefinitely large number of points, yielding heat in varying amount and intensity. The fuel had to be re-adjusted in the stove, twice during the afternoon, with distinct influence in cooling the surface of the stone; and farther variation must have been produced by the slight breeze which sprang up in the latter part of the afternoon.

(c). Heterogeneous medium: an aggregate of several minerals of different conductivity of heat, chiefly quartz, feldspars, biotite, and hornblende: the occurrence of these minerals in crystals of varying size, lying in all positions, with interstices of irregular size intervening: separation of the aggregate into laminae of varying thickness (mostly 2 to 3 centimeters) and texture, with the biotite-plates mostly arranged in parallelism with the lamination-planes and in part along those planes.

(d). Presence of moisture in the interstices, probably in varying quantity in different layers of the rock, and producing irregular conversion of sensible into latent heat, during the production and the escape of vapor.

(e). Radiation of heat and vapor, both from the heated surface, on the east face of the boulder, and laterally from the north face.

In considering the figures in the table, the influence of these, and probably other conditions of variation, is strongly marked. Taking as a standard the average number of seconds in time required for an increment of one degree of temperature (Centigrade) to a depth of one centimeter, we find great oscillation along any line, either of depth, as marked by a particular thermometer, or of period of time, particularly of the latter. At any depth, within about 8 or 9 centimeters from the surface, the average increment of  $1^{\circ}$  per cm. varies from 25 to over 50 seconds, say about 36 seconds; while at any periods, passing across the columns of depth, the average increment varies up to more than 100 seconds. At the extreme depths of 25

and 50 centimeters, which also were most affected by lateral radiation and loss of heat through the north face of the boulder, the average increment lessened to a rate of over 2 minutes for  $1^{\circ}$  of temperature per centimeter of depth.

It would have been interesting to repeat the experiment from the north side of the boulder, on a series of thermometers, with bulbs lying at successive depths along the direction of lamination or strike of the boulder. Our experiment has at least thrown light on some conditions and precautions, which would require attention, in properly carrying on a series of such experiments on the conduction of heat through various species of rock, in directions varying in reference to planes of structure.

The curve presents at a glance the practical result of our experiment, that the temperature of the melting-point of the paraffin-compound ( $63^{\circ}$  C.) reached a depth of 5 to 6 centimeters in about 2 hours.

#### 21. *Absorption-coefficients of Syene granite.*

With a view to determine the exact changes in physical condition in the interior of Syene granite, under the influence of long weathering, both by the conditions of the climate of Egypt and of that of New York, I have made the following experiments, with particular reference to absorptive power. The essential features of my method are founded on a distinction between two modes of absorption of liquid by a porous solid:

(a). *Lateral absorption, i. e.,* from one surface; such as occurs in construction, when ashlar is moistened by rain upon its face. The soaking up of water is here but partial, effected almost entirely by interstices *between* the constituent grains, which may be distinguished as the *rock-pores*:

(b). *Total saturation*, where water is forced into all the interstices of the rock, including the more minute interstices *within* the constituent mineral-grains, which may be distinguished as the *mineral-clefts*. This therefore includes the amount of liquid in the rock-pores, and the difference enables us to estimate the volume of the second class of voids.

All kinds of *mechanical* strain to which a rock may be subjected (such as tension, jar, frost, etc.) are likely to develop mainly an increased volume in the rock-pores; while the irregular contractions and expansions, incident to the combinations, losses, and solutions

which attend *chemical* decay, tend to develop mainly the microscopic clefts in the interior of mineral-grains.

The rock-pores connect in chains of easily communicating voids, forming an intricate network which freely imbibes water, by capillary attraction, from any moistened surface, until completely filled. The communication between the mineral-clefts is interrupted and difficult, and their occupation by liquid is slow, on account partly of their minuteness and partly of their content of air, probably as a condensed film. The distinction of the two classes of voids, of their origin, and of conclusions from their proportion, seems to me important.

The apparatus and process employed for the purpose need to be first described. After some modifications, they were applied by me some years ago to a long series of trials on building-stones of this country, and were found to yield uniform and satisfactory results.

The main apparatus consists of a low bell-jar, 12 inches in diameter and 6 inches in height, with glass knob for convenient handling; this stands in about half an inch of distilled water in a large shallow tray. Within the bell-jar and half immersed in the water, is a round, soft clay tile, with even and smooth upper surface, 9 inches in diameter and about 1 inch in thickness. Before use, this tile must be repeatedly boiled in distilled water to remove all soluble matter from its interstices.

On the top of the tile several pads of sheet-rubber, 3 to 4 inches across, are laid. In the centre of each pad a square opening, 1 inch on a side, is occupied by a pad of thick soft blotting-paper, which, of course, remains constantly saturated with water drawn up from the tile. Each of the rubber pads is also kept covered with a small low glass cover or inverted dish, to prevent the fall of condensed water from the vault of the bell-jar. The water lost by evaporation outside the bell-jar is constantly replaced, so as to keep a constant level. Without a suitable precaution, the raising of the bell-jar from the water would be accompanied by a sudden inrush of water and flooding of the tile. This is prevented, either by a short bent piece of glass tubing, which passes from outside down and around the edge of the bell-glass and so up into its interior, so as to provide constant communication between the air outside and in; or more conveniently by a half-inch hole bored through the vault of

the bell-glass, closed by a cork, which is removed every time, before the bell-glass is raised.

The stone to be examined is either cut into a dressed cube of an inch on a side, or broken into a fragment of about that form and size; with either, the result seems to be the same. A sawn cube is always previously digested in ether or chloroform to remove any oil or grease possibly adhering or absorbed during the sawing or handling. All cubes are first dried in a desiccator, over sulphuric acid. Before every weighing, the cube is wrapped tightly in a doubled sheet of tin-foil of known weight.

The process consists of the following steps: The cube, on removal from the desiccator, is weighed in its tin wrapper, pressed down into firm contact upon the yielding wet pad of blotting-paper, covered, and there left under the bell-jar until filled by lateral absorption. This usually requires 2 or 3 hours, and is often indicated by little drops of water exuding upon the upper surface. The cube is then quickly pressed surface-dry in a piece of filter-paper, instantly wrapped in the tin-foil and weighed. This is repeated to insure constant weight. The cube is then immersed in non-aërated distilled water and put in the vacuum of an air-pump until effervescence ceases, again wiped surface-dry, and weighed in its tin wrapper; this is repeated to constant weight. Finally the cube is weighed in distilled water at determined temperature.

Four specimens were examined in this way, viz.:—

A. Granite from the ancient quarry at Syene, selected from a large number of specimens, on account of its fresh appearance.

B. Granite from the Syene quarry, apparently showing slight decomposition, by dulled color and lustre, and by some fine cracks.

C. Fresh granite of the Obelisk, obtained in January, 1881, soon after the erection of the Obelisk, and probably derived from chip-pings off the heel of the shaft, done under direction of Commander Gorringe.

D. Flake of disintegrated granite, removed from surface of the Obelisk in 1885, supplied by the Park Commissioners.

The trial of these paired specimens yielded the following results:

The actual weights obtained, in grams, are given in the table beyond.

|   | Specimens tested.                | Dried cube. | Cube moistened by lateral absorption. | Cube saturated by immersion. | Cube in distilled water at 25° C. |
|---|----------------------------------|-------------|---------------------------------------|------------------------------|-----------------------------------|
| A | Fresh granite, Syene quarry      | 28.539      | 28.586                                | 28.595                       | 17.770                            |
| B | Decayed granite, Syene quarry    | 68.183      | 68.365                                | 68.436                       | 42.755                            |
| C | Fresh granite, Obelisk in 1881   | 82.415      | 82.483                                | 82.640                       | 51.193                            |
| D | Decayed granite, Obelisk in 1885 | 32.735      | 32.792                                | 32.886                       | 20.513                            |

From these weights the following coefficients have been calculated; *a* and *b*, in percentage of weight of the rock: *c*, *d*, and *e*, in percentage of its volume: and *f* and *g*, in percentage of its Total Voids.

*Determinations of Absorption of Syene Granite,  
fresh and decayed.*

| Specimens tested. | <i>a.</i>                          | <i>b.</i>               | <i>c.</i>           | <i>d.</i>               | <i>e.</i>    | <i>f.</i>   | <i>g.</i>       | <i>h.</i>         | <i>i.</i>                    |
|-------------------|------------------------------------|-------------------------|---------------------|-------------------------|--------------|-------------|-----------------|-------------------|------------------------------|
|                   | Coefficient of lateral absorption. | Saturation coefficient. | Rock voids (pores). | Mineral voids (clefts). | Total voids. | Rock pores. | Mineral clefts. | Specific gravity. |                              |
|                   |                                    |                         |                     |                         |              |             |                 | Mineral matter.   | Entire rock and interstices. |
| A                 | .165                               | .196                    | .434                | .083                    | .517         | 84          | 16              | 2.650             | 2.636                        |
| B                 | .267                               | .371                    | .709                | .276                    | .985         | 72          | 28              | 2.681             | 2.655                        |
| C                 | .083                               | .273                    | .216                | .500                    | .716         | 30          | 70              | 2.640             | 2.621                        |
| D                 | .174                               | .461                    | .461                | .759                    | 1.220        | 37          | 63              | 2.678             | 2.646                        |

I have long hoped to confirm and develop these results, by similar experiments on a more extended series of specimens of granite from Syene, for which I have been waiting. These were to include, especially, specimens of fresh rock, to be reached by blasting from some depth below the present surface in the quarries. On these, chemical analyses were also to be made. But the recent death, in the midst of his own useful investigations, of the friend, Mr. F. Cope Whitehouse, on whose offered assistance I relied to procure this material from Egypt, has decided me to publish at once the results so far obtained.

*22. The causes and progress of the decay of the Obelisk.*

From the foregoing figures the following conclusions, I think, may be safely drawn, even from this limited series; though we

must allow for differences in constitution of the rock, in considering such small quantities, and for unknown variations in the length of exposure of these specimens to the weather.

(1). This granite, from whatever source derived, is by no means a compact mass, but is traversed by interstices in notable proportion, amounting to (see column *e* on *total voids*) from one-half to over one per cent. of its volume, according to its fresh character or condition of incipient decay.

In other words, even the dense Syene granite is finely spongy throughout, in its freshest state.

(2). In regard to the rock aggregate, the fresh granite (*c*) from the Obelisk, probably broken from the ever sheltered heel of its shaft, apparently represents either accidentally the most compact variety, or else the freshest condition of the Syene granite in my series, retaining the lowest coefficient of lateral absorption (.083), *i. e.*, the smallest proportion of rock-pores, about  $\frac{1}{5}$  of one per cent. of the volume (.216). But in regard to the constituent minerals, the fresh granite, as just arrived from Alexandria, contained nearly 50 per cent. more voids (716 to 517) than that at Syene, chiefly in its more abundant mineral interstices. This may indicate the efficiency of hydration in the damper climate of the Egyptian sea-coast.

(3). The progress of decay of the surface chips of the granite, in the quarry at Syene, was attended with increase in the minute interstices of its component minerals rather than in the pores of the rock; the original relationship (columns *g* and *f*) 16 to 84 became 28 to 72.

This seems to show that, in the arid climate of Syene, the chief element of decay in the granite was chemical, consisting in the absorption of oxygen and water by its minerals. The limited absorption of the latter, however, is shown by the determination of the loss by incineration at 0.65 per cent., and in the microclin at 0.35 per cent.<sup>1</sup>

(4). The progress of decay in the granite of the Obelisk, on the other hand, from 1881 to 1885, has yielded an increased proportion of rock-pores; the relationship of 70 to 30 having changed to 63 to 37. The mineral voids have increased 50 per cent. (.500 to .759), and the rock-voids have more than doubled (.216 to .461).

This indicates the action of a chemical force on the minerals, increasing their clefts, and a still more efficient mechanical action;

<sup>1</sup> Delesse, *loc. cit.*, 489.

the latter, between the arrival of the Obelisk at New York and the autumn of 1885, had produced a widening of the pores in the surface of the rock and incipient disintegration. This seems to me to prove that the active absorption of water, in our rainy seasons, by the minerals on the surface of the Obelisk, was the first and a continuous cause of decay. But there was, as plainly, a rending force, apparently greater than that which can be attributed to expansion by hydration.

(5). One result of decay, both in the granite of the quarry at Syene and in that of the Obelisk during its  $4\frac{2}{3}$  years exposure in New York, consists in an increase of specific gravity, both in the mineral matter and in the entire rock with all its interstices. This is a further indication that the actual expansion by hydration, in the decayed surface, just referred to above, must have been very small, and that the rending force must be sought in some other direction.

The specific gravity of the granite of our Obelisk was determined by Persifor Frazer in mass, including its cavities, at 2.6618; when determined in grains of the size of a pea, at 2.7188; giving the weight of one cubic foot of the rock at 166.1625 pounds avoirdupois. According to G. W. Wigner, the specific gravity of the stone of the London Obelisk was 2.682; absorbent power of the fresh stone, at the rate of 5.4406 grams of water per square meter, and of the weathered surface at a rate six times as great.

There are only two other forces, to whose sudden application or increased action the rapid exfoliation of the surface of the Obelisk from 1881 to 1885 has ever been attributed.

One of these is our climatic variation in temperature, with frequent sudden changes within a single day, enhanced by the strong heat of the sun. But I have already shown, from the even wider ranges of temperature in the climate of Egypt, at a higher portion of the scale, and from the observed results upon the sun-exposed faces of all obelisks, that this supposed cause had little or nothing to do with the surprisingly sudden disintegration which attacked the Obelisk immediately after its arrival.

It seems therefore established that we must attribute those visible effects of decay entirely to the violent force which was then exerted upon the monolith, almost for the first time in all its history—that of frost. The power exerted by the expansion of water in freez-



ing, within the pores of a stone, is so well known, that it needs no discussion here.

It is therefore evident that, for the protection of the Obelisk from this fierce attack, it was only necessary to insure the complete exclusion of moisture.

Any process, however, in which waterproofing material is applied in solution, even to a theoretically dry stone, must be imperfect *per se*. On the evaporation of the solvent, which constitutes the chief volume of the solution, the outer pores of the stone, empty to a slight depth, are in large part simply lined instead of filled with the protective residue. Nor can this deficiency be supplied by further applications of the solution, in successive coats: for already many of the pores have been sealed to further permeation, and the result must be a merely superficial cellular coat. On the other hand, practically, in any large solid mass of stone or masonry exposed to the weather in our climate, the pores are already occupied, and permanently, almost to the surface, by water, even in the hottest and driest weather. This forbids the satisfactory penetration of a waterproofing solution to any material depth.

The process theoretically called for by the decaying Obelisk, in 1885, was one by which the pores of the granite should be first emptied of moisture to the depth of at least two inches, by some gently applied but long continued absorbent, such as dry air or gentle heat: and by which, secondly, the empty pores should be completely saturated to that depth with a liquid preservative, of melting-point above the mean temperature of the stone, strongly adherent, permanent under weathering, and solidifying with slightest possible contraction. These conditions were, I think, fortunately approached by the process then applied, and will be still more closely approximated by the modified process, recommended by the two Committees, for the special retreatment of the decayed spots upon the Obelisk.

As an additional means of protection to the injured surface, I have elsewhere<sup>1</sup> suggested the propriety of restoring the ancient gilded cap to the apex of the pyramidion, regilding the remainder of the surface of the pyramidion below the cap, and regilding the hieroglyphic intaglios on the four vertical faces of the Obelisk. Aside from the appropriateness of this restoration from the archæo-

<sup>1</sup> The Misfortunes of an Obelisk, 128.

logical point of view, already fully discussed in the paper referred to, such an impervious metal film would serve as an efficient covering, to shed rain-water, sleet, and melting snow from the sloping sides of the pyramidion and from the hollows of the deep intaglios which cover the shaft below. To these hieroglyphs the Obelisk owes its chief interest as a historical monument, and, unfortunately, their cavities and projections, although still preserved, have suffered the chief injury by the surface-decay. The regilding could be carried out at small expense, and would be a most useful ally to the waterproofing treatment. Nothing too much can be done by our City authorities to secure both the preservation and proper decoration of this unique Symbol of the Sun on American soil, and to offset the deplorable neglect of our City, up to 1885, in its care of this magnificent gift from a generous citizen, the late Mr. William H. Vanderbilt.

Finally, then, when we return to our rusty pebble and the Egyptian boulder, what conclusions may we fairly draw as to the conditions attending their decay?

A. The main agency, by far predominant over all others, in the decay of these granite masses, has been aërated rain-water; this has been aided in Egypt by extreme and constant oscillations of temperature. Their means of action have been two-fold.

(1). *Chemical*, by absorption of water, together with oxygen, in combination with part of the bases of the unlocked silicates, and gradual removal of the rest in solution, producing irregular changes of volume and proportionate increase of the mineral-clefts.

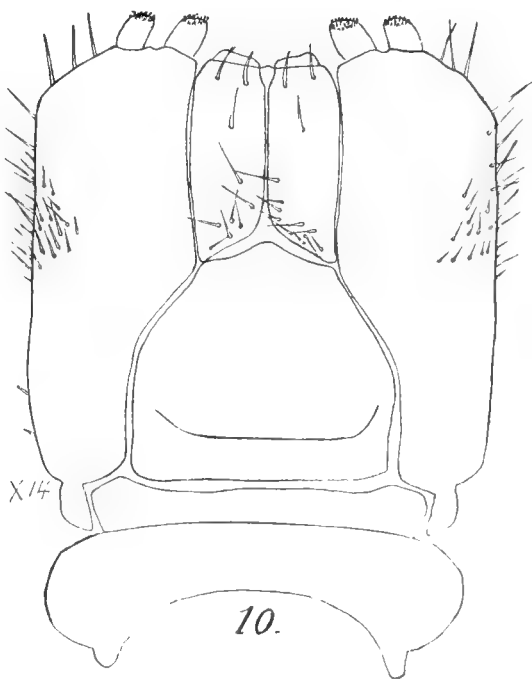
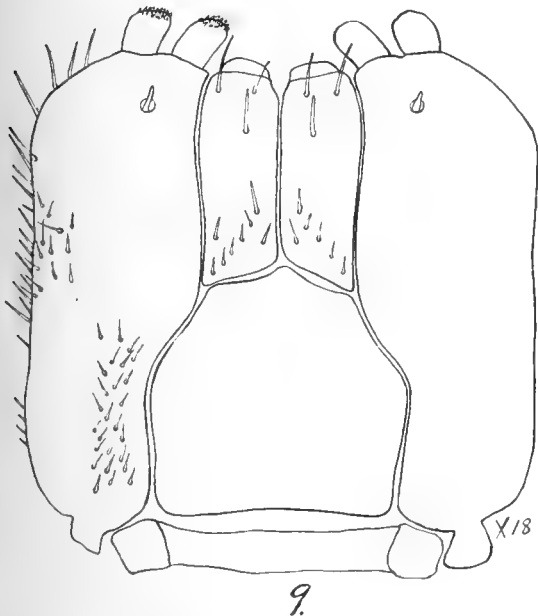
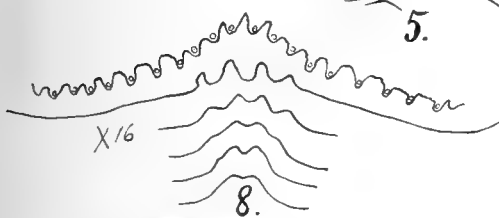
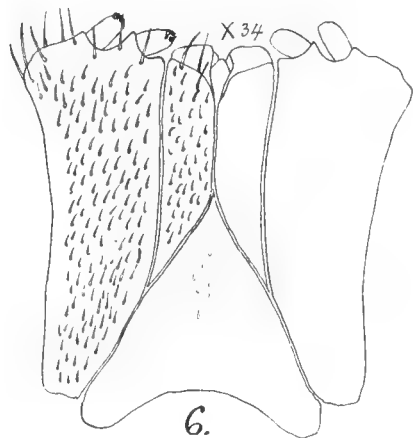
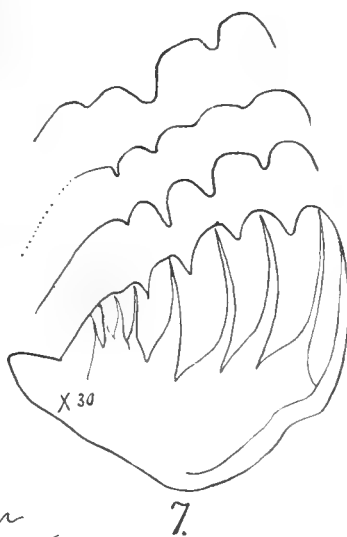
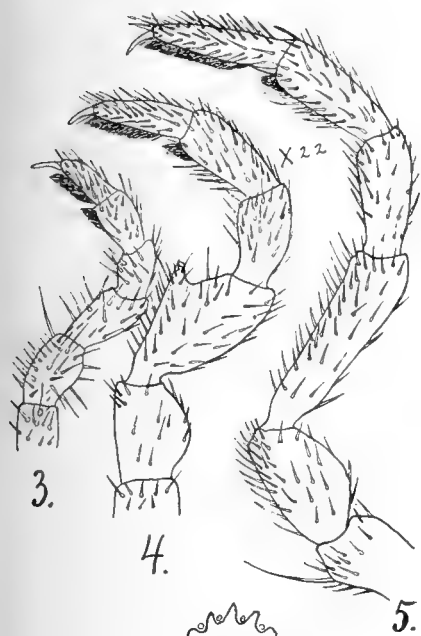
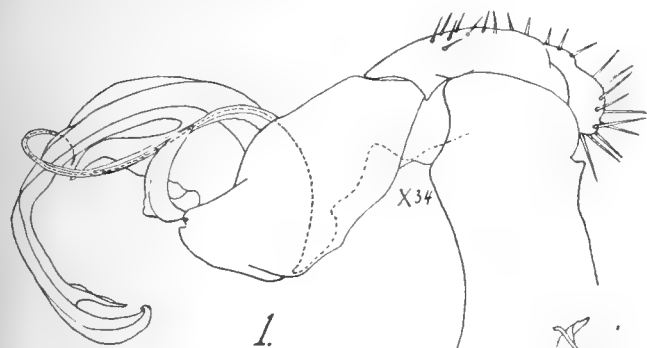
(2). *Mechanical*, through expansion by the sun's heat and contraction by night-radiation, aided by artificial roasting in some cases, tension and jar during transportation, further washing out of soluble matters, and, in our climate, freezing: all producing increase of the rock-pores.

B. The rate of action of each process is approximately indicated by some of the facts stated:—

(1). Chemical action with a limited rainfall, efficiently aided by oscillations of temperature, has tended, in the hot and comparatively arid climate of Syene, to cause the disintegration and removal of a layer, at least one centimeter in thickness, from the surface of the granite-cliffs at Syene, during a period of five to six thousand years. Forty-five centuries have been generally insufficient to produce any visible external injury and exfoliation.

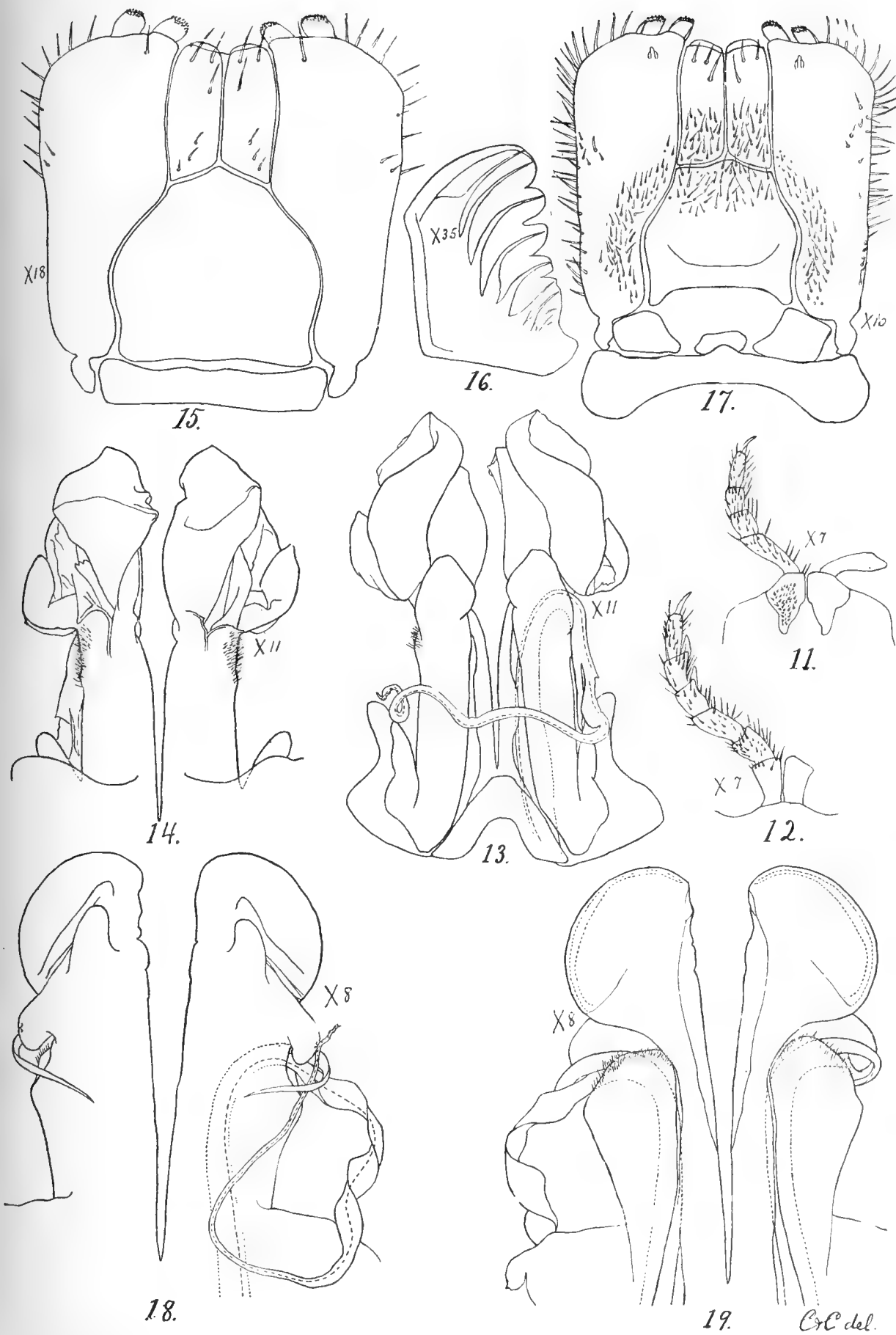
(2). Mechanical action, predominantly that of frost, has worked in the climate of New York at a vastly more rapid rate. On the surface of the Obelisk, already scarred and weakened by fire, it completely loosened a shell of about 0.73 mm. in thickness in  $4\frac{3}{4}$  years, equivalent to 1 centimeter in 70 years—or more nearly 1 centimeter in 50 years, when we allow for the decayed and partially loosened material which has not been removed from the surface of the monument. But although this rate far exceeds that of the estimate of Dr. Barnard (1 cm. in 6000 years) there is no evidence that it must be continuous; the chief exfoliation has been probably already effected in the weakened, thin outer layer of stone; the main stone below is practically sound.

It appears then that an ancient column of granite like this, while unfitted to mark the flying hours on a Roman dial, may yet serve us as a true gnomon to record some phases of rock-decay at intervals in geological time.



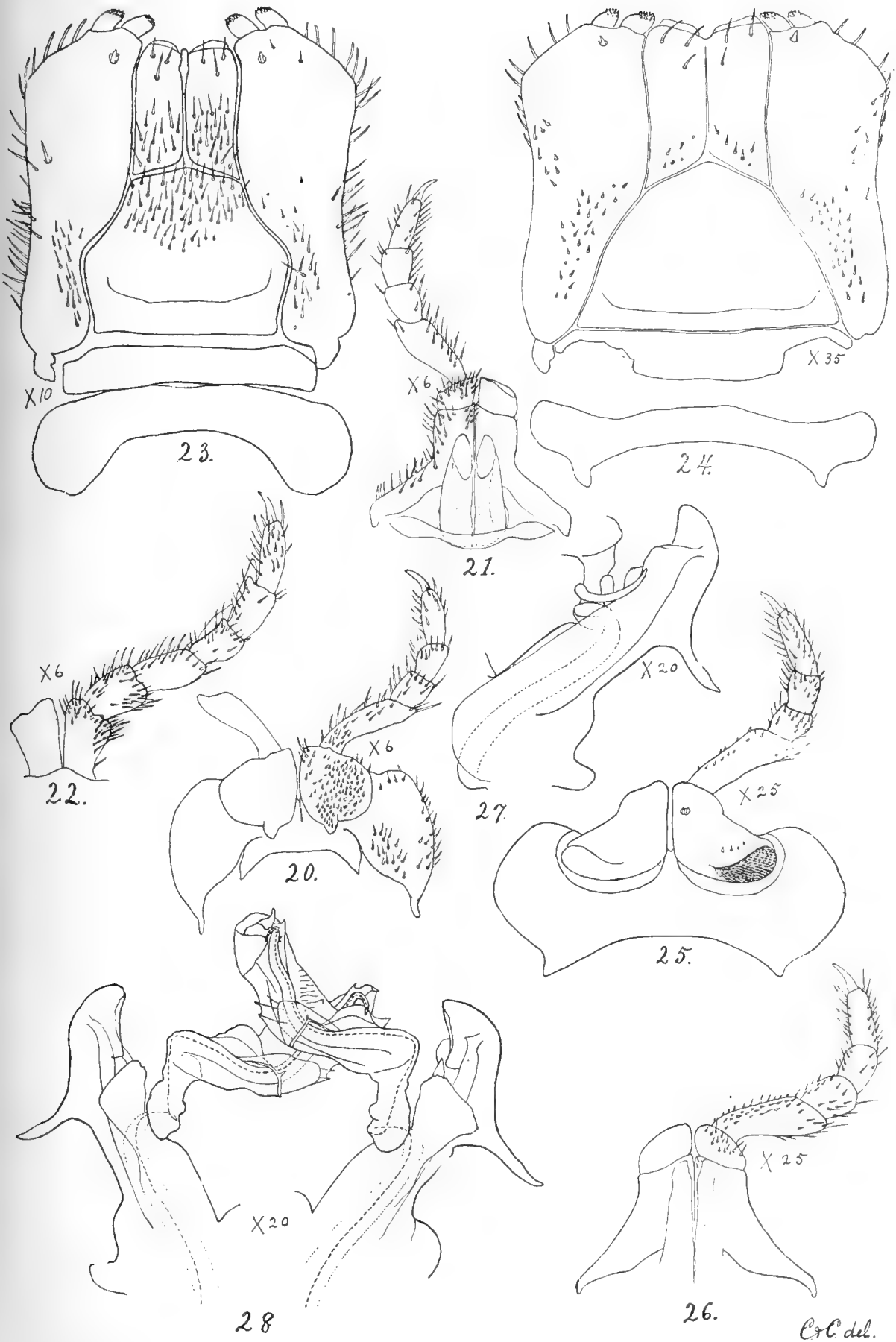
10.





C. C. del.

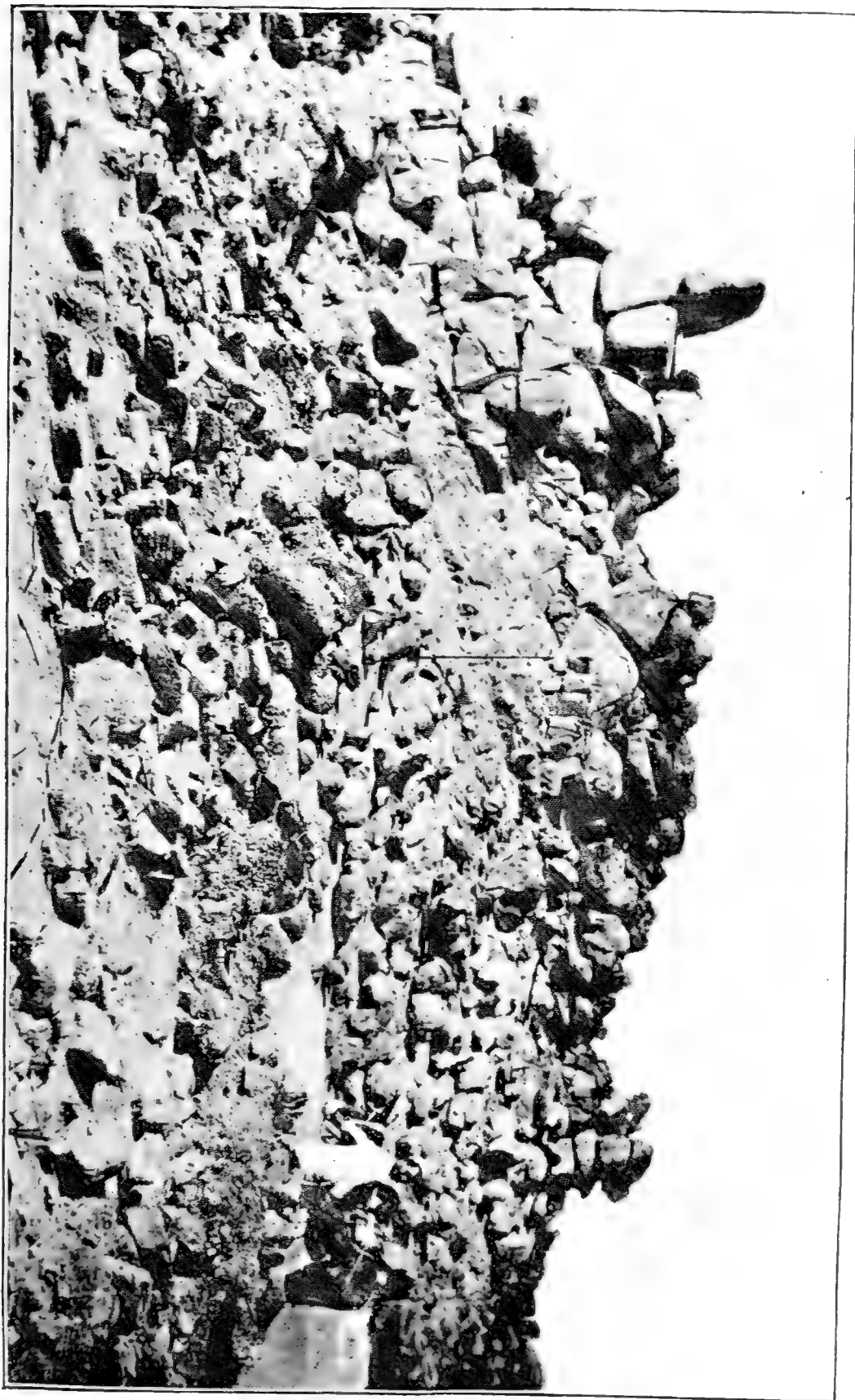




C. C. del.









# A N N A L S

## OF THE

### NEW YORK ACADEMY OF SCIENCES.

---

The "ANNALS," published for over half a century by the Lyceum of Natural History, are continued under the above name by the New York Academy of Sciences, beginning in 1877. Five volumes of the new series have now been issued, each covering three years (1877-9, 1880-2, 1883-5, 1886-8, 1889-91, inclusive).

With the beginning of the fourth volume, the Academy decided to change somewhat the mode of publication. The ANNALS are henceforth issued without particular reference to times or periods. The parts will appear as material for them shall be offered; each single part, or number, as before, will contain at least 32 pages, with or without plates; twelve numbers, as before, whenever published, will constitute a volume. The size and general character of the parts and volumes will not be changed; nor is it intended at all to reduce the average yearly amount of matter.

The ANNALS include the more extended and elaborate papers laid before the Academy. The briefer papers and discussions that form part of the Academy's meetings appear in its other publication, the TRANSACTIONS, which it is designed to issue promptly and regularly, so as to give a record of the current work of each year,—the single numbers appearing monthly (or double, bi-monthly), and eight single numbers forming an annual volume.

By vote of the Academy, both these publications will be sent FREE to its Resident and Honorary members. To non-resident members the price of the TRANSACTIONS will be \$3.00 per year.

To all others, prices will be as follows:

|  |               |
|--|---------------|
| Annals, single numbers,                      | Fifty Cents.  |
| “ double or multiple numbers, in proportion. |               |
| “ per volume (12 numbers),                   | Six Dollars.  |
| Transactions, per year,                      | Five Dollars. |
| “ single numbers,                            | Fifty Cents.  |

All communications should be addressed to

THOS. L. CASEY,  
*Army Building,*  
*New York.*

Or to

N. L. BRITTON,  
*Columbia College, New York.*

The Academy has for sale a number of back volumes of the ANNALS of both series, each containing twelve or more numbers; the price per volume is Five Dollars in the old (Lyceum) series, and Six Dollars in the new (Academy) series.

## CONTENTS.

|  | PAGE |
|--|------|
| I.—The Parallaxes of $\mu$ and $\theta$ Cassiopeiæ, deduced from Rutherford Photographic Measures. By HAROLD JACOBY . . . . .                  | 6    |
| II.—The Myriapoda Collected by the United States Eclipse Expedition to West Africa, 1889 and 1890. By O. F. COOK and G. N. COLLINS             | 24   |
| III.—Studies on the Life-history of some Bombycine Moths, with Notes on the Setæ and Spines of Certain Species By ALPHEUS S. PACKARD . . . . . | 41   |
| IV.—A Study of the New York Obelisk as a Decayed Boulder. By ALEXIS A. JULIEN . . . . .  | 93   |

Vol. VIII.

May, 1894.

No. 4.

ANNALS  
OF THE  
NEW YORK ACADEMY OF SCIENCES,  
LATE  
LYCEUM OF NATURAL HISTORY.



New York:  
PUBLISHED BY THE ACADEMY.  
1894.

OFFICERS OF THE ACADEMY.  
1894-95.

---

President.

J. K. REES.

Vice-Presidents.

R. P. WHITFIELD,                      HENRY F. OSBORN.

Corresponding Secretary.

T. L. CASEY.

Recording Secretary.

J. F. KEMP.

Treasurer.

CHAS. F. COX.

Committee of Publication.

J. A. ALLEN,                                      J. F. KEMP,  
HAROLD JACOBY,                                      H. F. OSBORN.  
THOS. L. CASEY (EDITOR).

## V.—*Reversal of Cleavage in a Sinistral Gasteropod.*

BY HENRY E. CRAMPTON, JR.

Read Feb. 12, 1894.

The purpose of the present preliminary notice is to communicate an interesting series of embryological facts which have not heretofore been published. They are the results of studies made during last December upon the cleavage of the eggs of our common freshwater Pulmonates, *Physa heterostropha*, and *Limnæa columella*. Of these it will be remembered that the adult *Physa* has a sinistral shell, and *Limnæa* a dextral shell, the more usual form.

It was by a most happy accident that these facts were brought to light. At the suggestion of Prof. E. B. Wilson, I was about to study the development of *Paludina*, which, according to von Erlanger, forms the mesoderm by archenteric pouches. As the Pulmonates were commoner at that time of the year, the idea occurred to me to study their development in order to have a more thorough basis for comparison, when I came to study *Paludina*. But it was with the full expectation of finding the usual method of cleavage, and not with any idea of the presence of variation.

Owing to the short time of my investigation I have demonstrated few stages beyond the formation of the mesoderm, which takes place at the 28-cell stage. But the early stages have been most thoroughly determined, and these I shall describe. I emphasize the point that these are the determinative stages, in which the orientation of the animal is completed, and are assuredly the most important.

The type of cleavage in these eggs is the spiral, well known in many forms, notably *Nereis* (Wilson, Journ. Morph., vol. vi, No. 3), *Umbrella* (Heymons, Zeit. f. wiss. Zool., Band 57, 1893), *Neritina* (Blochmann, Zeit. f. wiss. Zool., Band 36, 1882), *Crepidula* (Conk-



lin, Zool. Anz., No. 391, 1892), and others. To the facts of this nature, I add, as my results, that the *cleavage of Physa is typically spiral, but totally reversed*. This is not abnormal, for all the series obtained developed reversedly, while *Limnæa* eggs, laid in the same jars, proceeded in the regular direct manner.

The eggs are smaller in *Limnæa* than in *Physa*. Segmentation begins about five hours after deposition, and about two hours after the extrusion of the polar globules. As usual, the first cleavage-plane is meridional, dividing the egg into equal parts, anterior and posterior. The second plane, also meridional, divides each of these, forming four nearly equal blastomeres, *A, B, C, D* (Figs. 1 and 2), *D* being slightly larger than the others. The first evidence of variation in *Physa* appears at a late 2-cell stage. Here the spindles for the next cleavage, instead of being inclined from left below to right above, in side view, as they are in *Limnæa*, are inclined from *right* below to *left* above. This is a total reversion, which in the completed 4-cell stage (Fig. 2), brings about the reversion of the "cross-furrows." The appearance of these in *Limnæa* and other forms cited is that shown in Fig. 1.

And here it is plainly seen that the crossing of the upper and lower cross-furrows is an expression of a spiral cleavage; for the cells *B* and *D* being in contact at the lower pole, while *A* and *C* are in contact at the upper, it follows that *A* and *C* are at a higher level. And as *A* is separated off from *B*, and *C* from *D*, we have a spiral cleavage, to the left in *Limnæa*, and in *Physa* to the right. A very noticeable feature at this stage is the enormous blastocoel.

The third cleavage plane is equatorial, and separates the first group of micromeres,  $a^1, b^1, c^1, d^1$ , from the macromeres, *A, B, C, D* (Fig. 3). These smaller cells alternate with the macromeres, showing the spiral nature of the division. But it will be noticed that they are derived in a *left-handed* spiral, the reverse of the case in *Limnæa*; and that this direction is opposite to that of the spiral of the last division, as to be expected in a normal cleavage.

The twelve-cell stage occurs next. A second group of micromeres,  $a^2, b^2, c^2, d^2$  (Fig. 4), is given off from the macromeres in a *right-handed* spiral, this being opposite to their origin in other forms; and also alternating with the spiral of the third cleavage.

Then the cells of the first group of micromeres divide unequally (Fig. 5,  $a^{1.1}, a^{1.2}, b^{1.1}, b^{1.2}$ , etc.). Here again the reversal holds, as

their division here is in a *left*-handed spiral. In *Limnæa* and other forms, they divide to the right.

A twenty-four-cell stage obtains by the division at about the same time of the second group of micromeres and the macromeres. A third group of micromeres arises spirally to the *left*, reversing the condition in *Limnæa*. And moreover the cells  $a^2$ ,  $b^2$ , etc., divide at right-angles to the direction in other forms.

There are one or two most interesting questions which arise in view of the foregoing facts. I shall not attempt to discuss these, contenting myself with merely pointing out their interest. First, is there any correlation between the sinistral shell of the adult *Physa* and the unique method of cleavage? The answer to this will depend on further investigations on the embryology of sinistral forms. Heretofore, we have had slight evidence of reversed cleavage. *Planorbis*, as figured by Rabl (*Morph. Jahrbuch*, Band 5, 1879), is certainly reversed in some stages; whether this obtains throughout is uncertain from the figures. The only other case is that of *Janthina* (Haddon, *Quarterly Journ. Micro. Sc.*, vol. xxii, N. S., 1882); there is a figure of an eight-cell stage, which appears reversed. *Janthina* has an ordinary dextral shell.

Another important question is that relating to the origin of the mesoderm. In all the spiral forms known cytogenetically, the mesoderm arises from  $D$ , as one of the fourth group of micromeres, which is given off in a left-handed spiral. And as  $D$  is on the left side,  $d^4$  comes to lie at the median posterior part of the embryo. Now in *Physa*,  $D$  is on the right, and  $d^4$  must arise in a *right*-handed spiral; so that, while it occupies the same position as it does in other forms, still in *Physa*, it is derived from the opposite side of the egg. I shall not attempt to discuss whether this argues for isotropy or preorganization, but will reserve full treatment for the future.

# EXPLANATION OF PLATE V.

Fig. 1.—4-cell of *Limnæa*, from the animal pole.

Figs. 2, 3, 4, 5.—4-, 8-, 12-, and 16-cell stages of *Physa*, all from animal pole. I-I, first cleavage plane; II-II, second cleavage plane; *A*, *B*, *C*, *D*, macromeres;  $a^1$ ,  $b^1$ ,  $c^1$ ,  $d^1$ , first group of micromeres;  $a^2$ ,  $b^2$ ,  $c^2$ ,  $d^2$ , second group of micromeres;  $a^{1.1}$ ,  $a^{1.2}$ ,  $b^{1.1}$ ,  $b^{1.2}$ , etc., descendants of the first group of micromeres. The arrows show the direction of the spiral division.

Fig 2

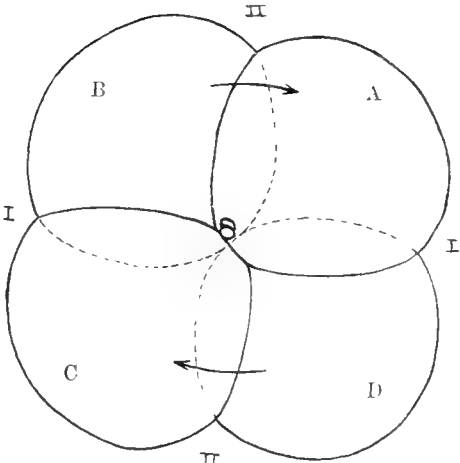


Fig 1

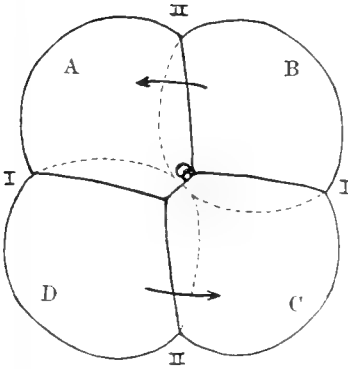


Fig 4

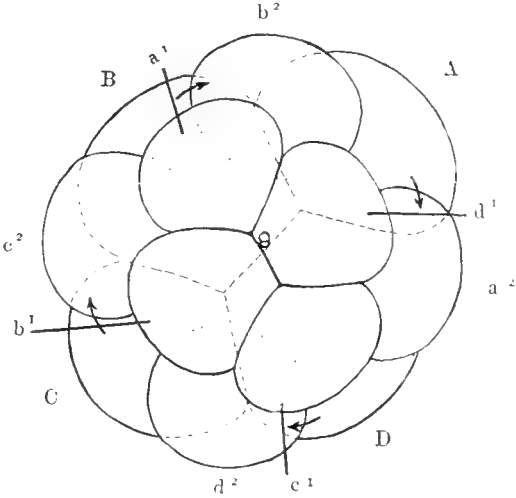


Fig 3

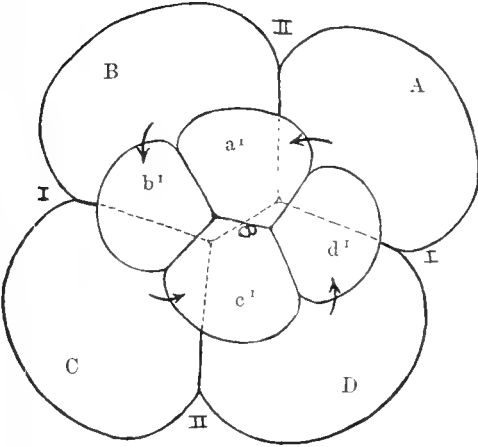
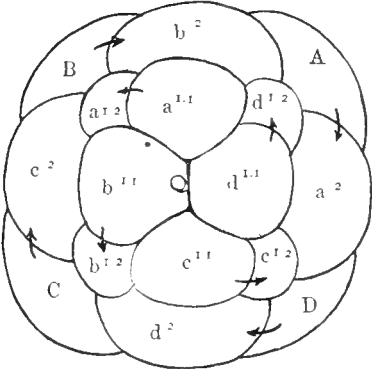


Fig 5





## VI.—*Certain New Derivatives in the Aromatic Series.*

BY HARWOOD HUNTINGTON.

Read March 19, 1894.

### TABLE OF NEW DERIVATIVES.

- Phenylacridin-azo-alphaNaphtol.  
Phenylacridin-azo-betaNaphtoldisulphonic acid, 2 : 6 : 8.  
Phenyldimethylacridin-azo-alphaNaphtol.  
Phenyldimethylacridin-azo-betaNaphtol.  
Phenyldimethylacridin-azo-Naphtylaminesulphonic acid.  
Amidoazobenzol-azo-Naphtylaminesulphonic acid, 2 : 7.  
Para-Anisidin-azo-alphaNaphtoldisulphonic acid, 1 : 4 : 8.  
Para-Anisidin-azo-betaNaphtylaminesulphonic acid, 2 : 5.  
Para-Anisidin-azo-betaNaphtol.  
Fluoren-disazo-betaNaphtylamine.  
Fluoren-disazo-beta-gammaNaphtylamine.  
Fluoren-disazo-alphaNaphtolsulphonic acid, 1 : 4.  
Fluoren-disazo-betaNaphtolsulphonic acid, 2 : 6.  
Fluoren-disazo-alphaNaphtol.  
Fluoren-disazo-betaNaphtol.  
Tetramethyldiamidodiphenylmethan-azo-betaNaphtylaminesulphonic acid, 2 : 5.  
Tetramethyldiamidodiphenylmethan-azo-betaNaphtylaminesulphonic acid, 2 : 6.  
Tetramethyldiamidodiphenylmethan-azo-betaNaphtylaminesulphonic acid, 2 : 7.  
Tetramethyldiamidodiphenylmethan-azo-beta-gamma-Naphtylaminesulphonic acid, 2—3.  
Tetramethyldiamidodiphenylmethan-azo-alphaNaphtol.  
Tetramethyldiamidodiphenylmethan-azo-alphaNaphtol sulphonic acid, 1 : 4.  
Tetramethyldiamidodiphenylmethan-azo-betaNaphtol sulphonic acid, 2 : 6.  
Tetramethyldiamidodiphenylmethan-azo-betaNaphtoldisulphonic acid, 2 : 6 : 8.  
Tetramethyldiamidodiphenylmethan-azo-betaNaphtoldisulphonic acid, 2 : 3 : 6.  
Aniline-azo-dialphaNaphtol.  
Aniline-azo-dibetaNaphtol.

Para-Nitraniline-azo-dialphaNaphtol.  
 Para-Nitraniline-azo-dibetaNaphtol.  
 Toluidine-azo-dialphaNaphtol.  
 Toluidine-azo-dibetaNaphtol.  
 Xylidine-azo-dialphaNaphtol.  
 Xylidine-azo-dibetaNaphtol.  
 Amidoazobenzol-azo-dialphaNaphtol.  
 Amidoazobenzol-azo-dibetaNaphtol.  
 Sulphanilicacid-azo-alphadiNaphtol.  
 Sulphanilicacid-azo-betadiNaphtol.  
 AlphaNaphtylamine-azo-alphadiNaphtol.  
 Naphthionicacid-azo-alphadiNaphtol.  
 Naphthionicacid-azo-betadiNaphtol.  
 BetaNaphtylaminesulphonicacid-azo-alphadiNaphtol.  
 BetaNaphtylaminesulphonicacid-azo-betadiNaphtol.  
 Chinolin-azo-betaNaphtylaminesulphonic acid, 2 : 5.  
 Chinolin-azo-alphaNaphtolsulphonic acid, 1 : 4.  
 Chinolin-azo-beta-gammaNaphtylaminesulphonic acid.  
 betaNaphtylaminesulphonic acid (2 : 6)-azo-alphaNaphtoldisulphonic acid, 1 : 4 : 8.  
 betaNaphtylaminesulphonic acid (2 : 5)-azo-betaNaphtol.  
 betaNaphtylaminesulphonic acid (2 : 5)-azo-betaNaphtoldisulphonic acid, 2 : 6 : 8.  
 betaNaphtylaminesulphonic acid (2 : 5)-azo-betaNaphtoldisulphonic acid, 2 : 4 : 8.  
 betaNaphtylaminesulphonic acid (2 : 5)-azo-alphaNaphtoldisulphonic acid, 1 : 4 : 8.  
 Naphthionic acid-azo-alphaNaphtoldisulphonic acid, 1 : 4 : 8.  
 Tribromaniline-azo-betaNaphtol.  
 Metadioxyazotribrombenzol.  
 Tribromaniline-azo-alphaNaphtolmonosulphonic acid, 1 : 4.  
 Tribromaniline-azo-betaNaphtolmonosulphonic acid, 2 : 6.  
 Tribromaniline-azo-betaNaphtoldisulphonic acid, 2 : 3 : 6.  
 Tribromaniline-azo-alphaNaphtoldisulphonic acid, 2 : 6 : 8.  
 Tribromaniline-azo-alphaNaphtylamine.  
 Tribromaniline-azo-betaNaphtylamine.  
 Tribromaniline-azo-betaNaphtylaminesulphonic acid, 2 : 5.  
 Tribromaniline-azo-betaNaphtylaminesulphonic acid, 2 : 6.

## PREFACE.

It is a wide-spread, popular idea that the Coal-Tar Industry has revolutionized the theory and practice of dyeing. This is only true in part, because the improvement made possible by the brilliant work of the leaders in Color-Chemistry has been in great measure annulled by the dyers, who, instead of using the best and most

reliable of the inventions, have fallen into the reprehensible habit of using those many fugitive derivatives of aniline with which the market is flooded, because they are a little cheaper. All the colors of the spectrum can now be made from the Coal-Tar Colors, and it is perfectly possible to make them thoroughly reliable and fast—fast to washing with hot and cold water, fast to acidulated water, or alkaline water, and what is perhaps the supreme test of a color, fast to the action of sunlight. If the dyers would conscientiously use the really good dyes from coal-tar, and avoid the worthless ones with which their trade is infested, the civilized part of the world could compete successfully with those dyes used by the makers of the Persian and Turkish carpets, in which the colors are as durable as the rugs themselves.

To-day it is a fact, that, in spite of the many valuable and reliable dyes, many of the old-fashioned dyes are not driven out of the market. The natural dyes are still used in immense quantities—Indigo for blue, Logwood for slates and blacks, Cutch for browns, Fustic for yellows, and Sumac for mode colors. Then there are the ancient uses of iron nitrate to make buffs with alkalies; the Prussian blues from iron nitrate and prussiate; the brown from manganese and alkalies; and the yellow from lead acetate and bichromate; all these are of daily application. In many cases it is a pity, and in most instances it is a sad waste of more or less expensive chemicals, but as yet, only in the case of cochineal and madder is the field completely occupied by the artificial dyes.

The writer cannot refrain from making one more observation here. It is that the methods of dyeing are sure to undergo a modification in the near future. Many dyes which now are made for the works at the aniline mill or factory, will be made at the works where the colors are applied to the fabric. As the patents run out the number of colors available for manufacture at the works will increase, and skilled color chemists will be as much a requisite in works of repute, as the now omnipresent and sometimes omniscient Superintendent. This is not necessarily a factor which will act to the detriment of the aniline manufactories, for there will always be a demand for aniline dyes in the dry state; the advantages of, and the necessities for the division of labor are too apparent to be gainsaid; but in large works there is a deal of saving and small economies to be effected, and the most progressive and enterprising establishments are sure to be the first to profit by the



intelligent, conscientious work of able and competent chemists of the new school.

In lieu of an historical introduction, I have drawn up a list of all the important dyes now prepared from coal-tar, and have indicated their modes of manufacture. This table forms no part of my thesis proper, which is strictly original work, but is offered to show the present status of the color industry, and to give its salient points. The list by no means comprises the whole number of dyes which have been made, but simply gives the principal ones, and those which have obtained a permanent place in the commercial world; and after all, that is a fair test of the usefulness and intrinsic value of any product.

NITRO DYES. Type,  $R.NO_2$ .

*Naphtol Yellow.*  $HNO_3$  on  $\alpha$ -Naphtoltrisulphonic acid, 1 : 2 : 4 : 7.

AZOXY DYES. Type,  $\begin{array}{c} R.N \\ | \\ R.N \end{array} \diagup O$

*Curcumine.*  $p$ -Nitrotoluolsulphonic acid and KOH.

HYDRAZONE DYES. Type,  $R-NH-NH-R$ .

*Tartrazine.* Phenylhydrazinemonosulphonic acid and dioxytartaric acid.

AZO DYES. Type,  $R.N=N.R$ .

*Cochineal Scarlet G.* Aniline and alphanaphtolsulphonic acid C, 1 : 5.

*Ponceau 4GB.* Aniline and betanaphtolsulphonic acid, Schæffer's, 2 : 6.

*Orange G.* Aniline and betanaphtoldisulphonic acid, "G", 2 : 6 : 8.

*Chrysoidine.* Aniline and phenylenediamine.

*Wool Scarlet R.* Xylidine and alphanaphtoldisulphonic acid, Schœllkopf's, 1 : 4 : 8.

*Palatine Scarlet.* Metaxylidine and naphtoldisulphonic acid.

*Erika B.* Dehydrothiometaxylidine and alphanaphtoldisulphonic acid.

*Fast Red A.* Naphthionic acid, 1 : 4, and betanaphtol.

*Azo-Rubine S.* Naphthionic acid and alphanaphtolsulphonic acid, Neville and Winther's, 1 : 4.

*Fast Red E.* Naphthionic acid and betanaphtolsulphonic acid, Schæffer's, 2 : 6.

*New Coccine.* Naphthionic acid and betanaphtoldisulphonic acid, "G", 2 : 6 : 8.

*Fast Red D.* Naphthionic acid and betanaphtoldisulphonic acid, "R", 2 : 3 : 6.

*Ponceau 6R.* Naphthionic acid and betanaphtoltrisulphonic acid.

*Azo-Coccine 7B.* Amidoazobenzene and alphanaphtolsulphonic acid, Neville and Winther's, 1 : 4.

*Brilliant Croceine.* Amidoazobenzene and naphtoldisulphonic acid, "G", 2 : 6 : 8.

*Croceine 3B.* Amidoazotoluol and naphtoldisulphonic acid, Schœllkopf's, 1 : 4 : 8.

*Double Scarlet.* Amidoazobenzolsulphonic acid and betanaphtol.

*Biebricher Scarlet.* Amidoazobenzoldisulphonic acid and betanaphtol.

*Ponceau S extra.* Amidoazobenzoldisulphonic acid and betanaphtoldisulphonic acid, "R", 2 : 3 : 6.

*Croceine Scarlet 7B.* Amidoazotoluolsulphonic acid and betanaphtolsulphonic acid, Bayer's, 2 : 6.

*Bordeau G.* Amidoazotoluolsulphonic acid and betanaphtolsulphonic acid, Schæffer's, 2 : 6.

*Jet Black R.* Amidobenzoldisulphonic-acid-azoalphanaphtylamine and phenylalphanaphtylamine.

*Naphtol Black 6B.* Alphanaphtylaminedisulphonic-acid-azonaphtylamine and betanaphtoldisulphonic acid, "R", 2 : 3 : 6.

*St. Denis Red.* Diamidoazoxytoluol and alphanaphtolsulphonic acid, Neville and Winther's, 1 : 4.

*Chrysophenine.* Ethylring Brilliant Yellow.

*Cresotine Yellow.* Benzidine and cresotinic acid.

*Chrysamine G.* Benzidine and salicylic acid.

*Diamine Black R.* Benzidine and amidonaphtolsulphonic acid.

*Sulfon-Azurine.* Benzidinsulfondisulphonic acid and phenylbetanaphtylamine.

*Delta-purpurine 5B.* Tolidine and naphthylaminesulphonic acid.

*Brilliant Congo R.* Tolidine and naphthylaminesulphonic acids, "R", 2 : 3 : 6, and Bronner's, 2 : 6.

*Toluylene Orange R.* Tolidine and toluylenediaminesulphonic acid.

*Rosazurine G.* Tolidine and methylbetanaphthylaminesulphonic acid.

*Benzoazurine G.* Dianisidine and alphanaphtolsulphonic acid, Neville and Winther's, 1 : 4.

*Benzopurpurine 10B.* Dianisidine and naphthionic acid.

#### OXYKETONE DYES.

*Alizarine Black S.* From dinitronaphtaline.

*Alizarine No. 1.* From anthrachinonemonosulphonic acid.

*Alizarine SDG.* From anthrachinonedisulphonic acid.

*Alizarine RX.* From beta-anthrachinonedisulphonic acid.

*Alizarine Orange.*  $\text{HNO}_3$  on alizarine.

*Alizarine Powder 5WS.*  $\text{H}_2\text{SO}_4$  on alizarine.

*Alizarine Blue.* Glycerine and  $\text{H}_2\text{SO}_4$  on betanitroalizarine.

#### DI-PHENYL-METHANE DYES.

*Auramine O.* Tetramethyldiamidobenzophenone and  $\text{AmCl}$  and  $\text{ZnCl}_2$ .

#### TRI-PHENYL-METHANE DYES.

*Malachite Green.* Benzaldehyde and dimethylaniline.

*Brilliant Green.* Benzaldehyde and diethylaniline.

*Magenta.* Aniline and toluidine.

*Methyl Violet.* Dimethylaniline.

*Hofmann's Violet.* Action of methyl halogens on Magenta.

*Methyl or Cotton Blues.* Sulfuriring Triphenyl-p-Rosaniline.

*Alkali or Nicholson's Blue.* Sulfuriring Aniline Blue.

*Fluoresceine, or Uranine.* Phthalic acid anhydride and resorcin

*Eosines.* Bromiring Fluoresceine.

*Erythrosine.* Iodiring Fluoresceine.

*Phloxine.* Bromine on tetra-chlor-fluoresceine.

*Rose Bengale.* Iodine on tetra-chlor-fluoresceine.

*Galleine.* Phthalic acid anhydride and gallic acid.

*Coerulein.* Galleine and  $\text{H}_2\text{SO}_4$ .

# INDOPHENOLS.

*Indophenol.* Nitrosodimethylaniline and alpha-naphthol.

## OXAZINE AND THIAZINE DYES.

*Gallocyanine.* Nitrosodimethylaniline and gallic or tannic acid.

*Fast Black.* Nitrosodimethylaniline and m-oxydiphenylamine.

*Methylene Blue.* From p-Amidodimethylaniline and dimethylaniline.

*Toluidine Blue.* From p-Amidodimethylaniline and o-toluidine.

## SAFRANINES.

*Safranine.* Oxidation of p-Toluyldiamine, Aniline and o-Toluidine.

## INDULINES AND NIGROSINES.

*Nigrosine.* Action of  $H_2SO_4$  on Indulines; latter from amidoazobenzene heated with aniline.

*Paraphenylenblue R.* Phenylendiamine on amidoazobenzene.

## ARTIFICIAL INDIGO.

*Indigo Salt.* Bisulfite compound of o-nitro-phenyl-lactic acid methyl-ketone.

## CHINOLINE DYES.

*Chinolin Yellow.* Chinaldin and phthalic acid anhydride.

## ACRIDINE DYES.

*Phosphine.* Bye-product in manufacture of Magenta.

## THIO-BENZYL DYES.

*Primuline.* p-toluidine heated with S., and sulfuring the product.

## DYES OF UNKNOWN CONSTITUTION.

*New Gray.* Boiling nitrosodimethylaniline with  $H_2O$  or  $C_2H_5OH$ .

*Aniline Black.* Oxidation of aniline with chlorates, chromates or copper salts.

*Cachou de Laval.* Fusing organic substances, as starch, bran, etc., with  $\text{Na}_2\text{S}$ .

*Hemolin.* Action of  $\text{NaNO}_2$  on logwood.

This list covers the whole territory of the Coal-Tar Colors, and gives representatives of every class of artificial dyes. I now pass to the original work. It is a pleasure and a privilege to express obligations and gratitude to Professors Charles F. Chandler and Charles E. Colby for their kind encouragement and many favors extended while this thesis was in the process of construction. The creditors have been well chosen by their debtor, who only becomes one of a large number.

THE PROPOSITIONS which this thesis undertakes to establish are:—

- I. That Fluoren is capable of giving derivatives which will compare with the dyes from benzidine, tolidine, and dianisidine.
- II. That Leuk-Auramine can be used to give very resistant colors.
- III. That Di-Naphtols increase the strength of dyes as they heighten the molecular weight.
- IV. That Chinoline will give reliable colors.
- V. That Schœllkopf's Acid, 1 : 4 : 8, gives, as a rule, colors which are fast to light.
- VI. That Bromine is disadvantageous in the Azo-Group.

The work described in the following pages was undertaken in the hope of making new derivatives of coal-tar which would rival the dyes already in commerce. Many now in common use in the practical world give colors which are fast in some respects, and not easily to be surpassed in their special qualifications. But there are no dyes which combine all the desirable qualities. To be perfect a dye must be able to withstand prolonged exposure in the sunlight, and further, resist washing with all the ordinary household chemicals.

To give an idea of the state of the field in which the work of this thesis was done, a brief statement of the best three starting-points for azo dyes is given here.

a. Benzidine,  $\begin{array}{c} \text{C}_6\text{H}_4\cdot\text{NH}_2 \\ | \\ \text{C}_6\text{H}_4\cdot\text{NH}_2 \end{array}$  is used for yellows, blacks, and reds in the cases of the dyes—

*Chrysamine G.*, made with benzidine and salicylic acid.

*Diamine Black*, benzidine and amido-naphtol-sulphonic acid.

*Diamine Fast Red*, made from benzidine and amidonaphtolsulphonic acid with salicylic acid.

*Diamine Red NO*, manufactured from ethoxybenzidine and naphthylamine sulphonic acid.

*Diamine Blue 3R*, from ethoxybenzidine and alphaNaphtol-sulphonic acid.

b. Tolidine,  $\begin{array}{c} \text{C}_6\text{H}_3\cdot\text{CH}_3\cdot\text{NH}_2 \\ | \\ \text{C}_6\text{H}_3\cdot\text{CH}_3\cdot\text{NH}_2 \end{array}$  is used for a number of good colors—reds, yellows, oranges, and pinks.

*Benzopurpurine 4B*, made from diazotized tolidine and naphthionic acid.

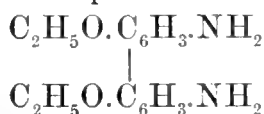
*Benzopurpurine B*, from tolidine and naphthylamine-sulphonic acid, 2 : 6.

*Chrysamine R*, from benzidine and salicylic acid.

*Toluylene Orange*, from tolidine and toluylendiaminsulphonic acid.

*Rosazurine B*, from tolidine and methyl-naphthylamine-sulphonic acid.

c. And there are a number of dyes, blues and reds, made from dianisidine, which hold a firm place in the commercial world. Dianisidine is,



and is used for

*Benzoazurine G*, where the dianisidine is diazotized and coupled with naphhtolsulphonic acid, 1 : 4.

*Benzopurpurine 10B*, dianisidine and naphthionic acid, 1 : 4.

From an observation of the constitution of the benzidine, tolidine, and dianisidine, it becomes evident that the chemicals which give the best results must have, first, the amido group; second, as much the polycyclical construction as possible; and thirdly, should have the highest possible molecular weight.

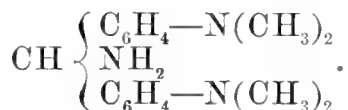
I. The first chemical which was taken up in the course of these researches, as a chemical possessing the desired properties, was



As had been foreseen, fluoren gave several very interesting dyes, all of which had the properties most sought for in good colors—

brightness and stability. The results are given in detail in Part Second of the thesis.

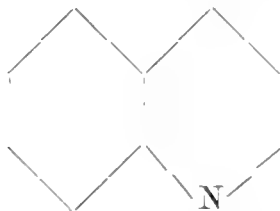
II. Another hold on the subject was suggested to the writer on noticing the composition of leuk-Auramine,



That this compound was diazotizable was readily seen; and that if it would link with the naphthols, naphtylamines, and their sulphonic acids, it would give dyes with the unique characteristic of being the first dye which had been made where the diphenyl-methane group was linked with naphthols. Success was attained in the coupling, and colors were made which possessed many desirable properties. The detailed work of the experiments are given in the technical part of the thesis.

III. For increasing the complexity of the molecule, it was determined to use dinaphthols in lieu of the ordinary naphthols; this increased the molecular weight of the dyes made, and although it is early to predict marked success, it is to be said that the colors dyed from the dinaphthols are resisting the action of light to a remarkable degree.

IV. Chinoline offered another chemical as a proper subject for investigation, as it had a polycyclical formation, was of considerable molecular weight, and amido groups could be put into the molecule.



When changed to a nitro derivative, and then reduced to the amido form, and subsequently diazotized and coupled with naphthol or naphtylamine, sulphonic acids, several new compounds with the desired characteristics were obtained.

V. It had long been noticed by the writer that the Schœllkopf's acid,  $\text{C}_{10}\text{H}_5\text{.OH}(\text{SO}_3\text{H})_2$ , 1 : 4 : 8, gave staunch azo dyes. Those which are already commercial articles are—

*Wool Scarlet R*, where xylydine is diazotized and linked with the Schœllkopf's acid.

*Croceine 3B*, which uses amido-azo-toluol.

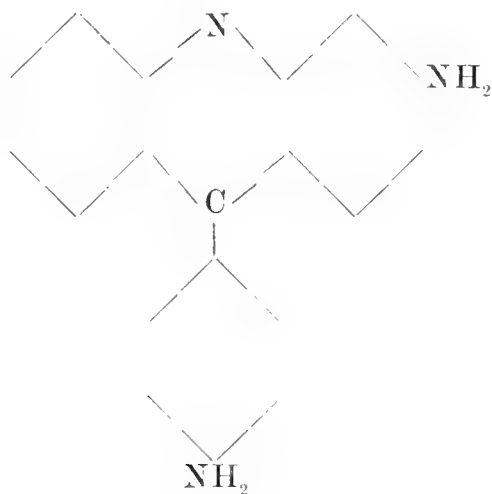
*Bordeau G*, in which instance amidoazotoluolmonosulphonic acid is used.

In part II of this thesis three new dyes are described which have been made from the Schœllkopf's acid by different amido derivatives.

VI. In proving that bromine was not advantageous, the work simply resolved itself to the making of a series of well-known dyes, and then making dyes of precisely similar character, starting with chemicals into which bromine had been introduced. Three atoms of bromine were used in all the cases. The results show that bromine throws the hue of a dye toward the orange in the case of the azo dyes. In the case of eosines, bromine is essential to the formation of the color; here it turns the shade away from the desired clear red. The manner in which the work was done is shown in the practical work of the thesis.

A considerable number of other researches were made in the course of the year, and some of them gave very interesting results, and will lead to further work. But it has been decided not to incorporate them in this thesis, as the main points which the thesis attempts to prove are decided by the results obtained in the work already outlined, and given in detail in the latter part of the work. It may be as well to mention some on this additional work; chrys-aniline when diazotized and linked with alphanaphtol gave a dark purple (sample No. 9), and when coupled with the "G" salt, beta-naphtol-disulphonic acid, 2 : 6 : 8, a bright red dye (sample No. 10).

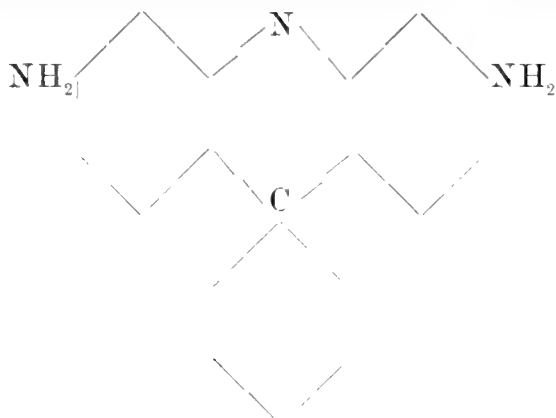
Chrysaniline is,



Benzoflavine, the isomer of Chrysaniline, gave results which were not uninteresting. With alpha-naphtol it gave a crimson (sample

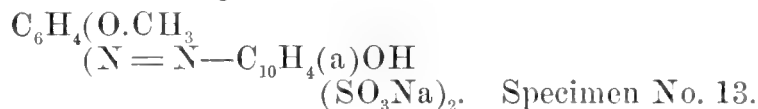


No. 11); with beta-naphtol also a crimson (sample No. 12). Naphthylamine-sulphonic acids generally gave reds. Benzoflavine is—



Amidoazobenzene has been studied a great deal, but the writer has been able to get new derivatives from it. The dyes now known are Sudan III; Azo-Coccine 7B; Crocein B; Brilliant Crocein; Ponceau SS; and Ponceau 5R. The author diazotized in the usual manner, and made four different browns or drabs, and one red, the last being made with the union of the diazotized amidoazobenzene with the Bayer's acid, 2 : 7, and it was found to have the formula,  $C_6H_5.N=N.C_6H_4.N=N-C_{10}H_5(SO_3Na).NH_2$ .

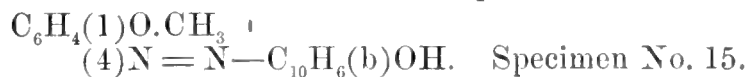
Ortho-Anisidine,  $C_6H_4(1)O.CH_3.(2)NH_2$ , has been used since 1878, when it was applied in the formation of Anisol Red, sometimes called Anisidine Ponceau. Azo Eosine is another derivative from the ortho-anisidine. But para-Anisidine seems not to have been used. Three new dyes were made, one a pink, by the application of Schœllkopf's acid,



The second an orange with Dahl's acid,



The third a Bordeaux with beta-naphtol,

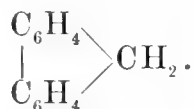


## PART II.

### PRACTICAL WORK ON THE NEW DERIVATIVES.

I. The use of the three compounds, benzidine, tolidine, and anisidine, suggested the thought, that if other compounds of similar character—that is, bearing amido groups, possessing if possible a polycyclical structure, and of high molecular weight—were to be applied, perhaps dyes would result which would be as good or better.

Fluoren, therefore, was taken in hand. It has the formula,

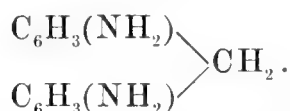


Fluoren has never been developed, probably on account of its high price. But in the coal-tar industry, the price of a chemical is never an obstacle which stands in the way of its application in a color for a very long time, as means are eventually found for the more economical manufacture of the desired compound. As, for instance, the alizarine industry, where the anthrachinone was only a chemical curio in museums until its presence in enormous quantities was wanted, when it became as reasonable in cost as could be expected.

Fluoren, or diphenyl-methane, is found in coal-tar, and can be synthesised by passing diphenyl through hot tubes; or by the distillation of diphenyl-ketone with zinc dust; or treating diphenyl-ketone with phosphorous and hydriodic acid; and also by distillation of phenanthrachinone with lime.

Fluoren is changed to dinitro-fluoren by adding it to a mixture of equal parts of nitric and glacial acetic acids. The fluoren which was unconverted was separated from the dinitrofluoren by washing with hot alcohol; then it was crystallized from glacial acetic acid. Fluoren has a melting-point of 112; the dinitro-derivative melts at 199–201.

This dinitro-fluoren was changed to the diamido derivative by the addition of tin to the acid solution. The formula of the diamido fluoren is,



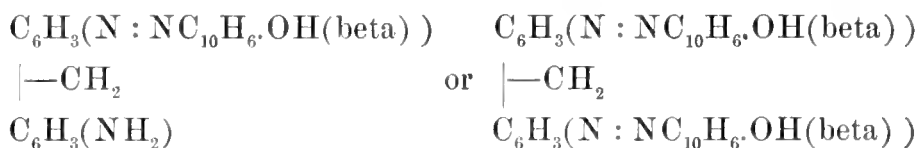
On diazotizing two kilos of this with seven hundred grammes of sodic nitrite and twelve hundred grammes of hydrochloric acid of twenty Baumé, the diazotized compound will link with different naphthols, naphthylamines, and their sulphonic acids, to give the results herewith appended.

|  |                      |
|--|----------------------|
| beta-Naphtylamine, . . . . .                               | Brown.               |
| beta and gamma naphtylamine, . . .                         | Red, Sample No. 6.   |
| Neville and Winther's, Naphtol-sulphonic, 1 : 4, . . . . . | Red.                 |
| Schæffer's acid, naphtol-sulphonic, 2 : 6, .               | Purple.              |
| alpha-Naphtol, . . . . .                                   | Orange, Sample No. 7 |
| beta-Naphtol, . . . . .                                    | Rose, Sample No. 8.  |

The reaction is facilitated by stirring, and by heating the liquid to about 80 degrees Centigrade. The dye is precipitated by the addition of sodic acetate and common salt; then it is pressed, dried, and analysed.

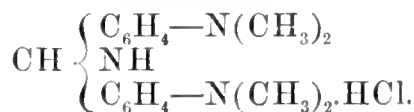
The dyes produced by the union of the diazotized diamido-fluoren and the different naphthylamine sulphonic acids, are all reds, soluble easily in water with a yellowish-red coloration; with hydrochloric acid they turn to a pink, if the acid is fully concentrated; with concentrated sulphuric acid the dyes dissolve, and give a violet similar in hue to the Hofmann's violet; with alkalies a yellow precipitate is produced.

It was desired to find out whether the diazotization effected both the amido groups, or only one. Whether the formula of the new coloring matter, in the case, for instance, of beta-Naphtol, was



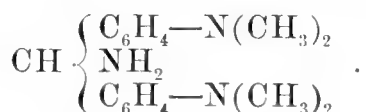
Analysis showed that both amido groups were diazotized and were linked.

II. The second line of work was begun with the diphenyl-methane compound, Auramine, which has the formula,

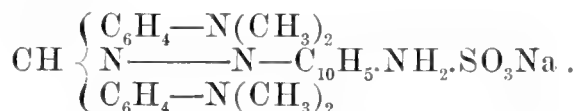


Auramine O should be used, for Auramine I or II is not pure.

This can be reduced by the action of sodium-amalgam, or indeed any reducing agent, to the form of Leuk-Auramine,



If three kilos of the Auramine has been taken in the beginning of the operations, seven hundred grammes of sodic nitrite should be employed in the diazotization, with twelve hundred grammes of hydrochloric acid of twenty Baumé. The reaction is complete in the course of half an hour, when the coupling is proceeded with. It should be noted that it is not necessary in this reaction to isolate the diamido product in the dry or solid state; the coupling with the desired naphtol can be effected just as well in the same solution where the reduction has taken place. In the instance of naphtylamine-sulphonic acid, 3.22 kilos are taken. Coupling is facilitated by stirring and by heating the liquid to about eighty degrees Centigrade. The dye is precipitated by the addition of sodic acetate and common salt. Then it is filtered out, pressed, dried, and analysed. In the case of naphtylamine-sulphonic acid, the dye is proved to have the constitution,



Other compounds can be linked, as is shown in the table which is appended.

|  |                     |
|--|---------------------|
| Naphtylamine-sulphonic acid, Bronner's, 2 : 6, | Red.                |
| Naphtylamine-sulphonic acid, Dahl's, 2 : 5,    | Red, Sample No. 22. |
| Naphtylamine-sulphonic acid, Bayer's, 2 : 7,   | Brown.              |
| Naphtylamine-sulphonic acid, mixture of        |                     |
| 2 and 5, . . . . .                             | Red, Sample No. 23. |
| alpha-Naphtol, . . . . .                       | Orange.             |
| Naphtol-sulphonic acid, N. and W., 1 : 4,      | Rose.               |
| Naphtol-sulphonic acid, Schæffer's, 2 : 6,     | Brown.              |
| Naphtol-disulphonic acid, 2 : 6 : 8, "G",      | Orange, bright.     |
| Naphtol-disulphonic acid, 2 : 3 : 6, "R",      | Orange, dull.       |

III. The third line of working, employed in the thesis commenced with the naphtols, and employed the di-naphtols, as they have a higher molecular weight.

The naphtols, both alpha and beta, are used in the manufacture

of many dyes, and the most important can be so readily seen in the table given below, that they are not further specified here.

Di-naphtols are made by heating naphtols with water, and then cooling; then the liquid is filtered, and to the filtrate ferric chloride is added until the violet color will not increase in intensity. Filter, dry, and recrystallize.

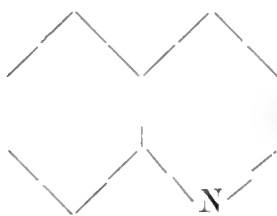
The reaction runs in accordance with the following equation,



|                 | a-Naphtol.                | a-di-Naphtol.    | b-Naphtol.              | b-di-Naphtol. |
|-----------------|---------------------------|------------------|-------------------------|---------------|
| Aniline,        | New red,                  | Black-violet,    | <i>Sudan I</i> ,        | Orange.       |
| p-Nitraniline,  | Rose,                     | Violet,          | <i>Ingrain red</i> ,    | . . .         |
| p-Toluidine,    | Bordeau,                  | Rose,            | Brick red,              | Yellow.       |
| Xylidine,       | Black-brown,              | Bordeau, No. 24, | <i>Sudan II</i> ,       | Orange.       |
| Amidoazobenzol, | Black-violet,             | Violet,          | <i>Sudan III</i> ,      | Rose.         |
| Sulphanilic,    | <i>Naphtol orange</i> ,   | Good red,        | . . . .                 | Red.          |
| a-Naphtylamine, | <i>Sudan brown</i> ,      | Black,           | . . . .                 | . . .         |
| b-Naphtylamine, | . . . .                   | . . . .          | <i>Carmin naphtha</i> , | . . .         |
| Naphthionic,    | <i>Naphtylam. brown</i> , | Violet-black,    | <i>Fast red A</i> ,     | Brown-red,    |
|                 |                           | No. 25,          |                         | No. 26.       |
| Bronner's,      | <i>Fast brown 3B</i> ,    | Red,             | <i>Double brilliant</i> | Rose.         |
|                 |                           |                  | <i>Scarlet</i> ,        |               |

Italicized names are old dyes.

IV. *Chinoline*, with its bi-cyclical constitution, gave a suggestion for another line of work which it was hoped would terminate successfully.



Chinoline is found in coal-tar, and is also made artificially by heating in a return condenser a mixture of nitrobenzene, aniline, glycerine, and sulphuric acid.

The manner of working with the chinoline was as follows: First, it was nitrated by allowing a solution of chinoline in nitric acid to run into a mixture of nitric and sulphuric acids; this nitrochinoline was reduced to the amido-chinoline, and the amido compound diazotized in the usual way, and then coupled with sulphonic acid salts of naphtylamines and naphtols. The most interesting results were the following:—

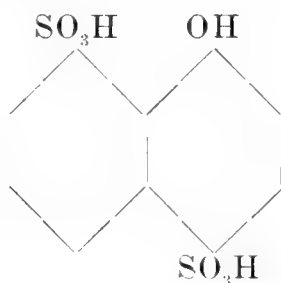
When coupled with equal molecules of Dahl's acid, naphtylamine-sulphonic acid, 2 : 5, a red dye was produced. Specimen is annexed, labelled No. 16.

When combined with Neville and Winther's acid, naphtol-sulphonic acid, 1 : 4, a crimson dye was made. Specimen No. 17.

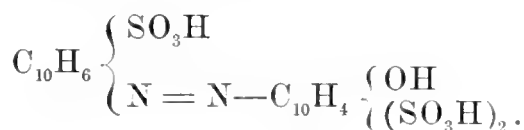
When coupled with the technical mixture of beta and gamma naphtylaminesulphonic acids, a brown-red was produced. Specimen No. 18.

All the dyes, No. 16, No. 17, No. 18, are precipitated by the addition of common salt, then filtered out and dried.

V. The fact that Schoellkopf's acid, alphaNaphtoldisulphonic acid, 1 : 4 : 8, gave nearly, if not quite, the fastest of the colors



of the Azo Group, was proved by a series of experiments for other dyes. Bronner's acid, or naphtylamine-sulphonic acid, 2 : 6, was worked upon for new derivatives, and although it has been used with a-Naphtol for Fast Brown 3B; and with beta-Naphtol for Double Brilliant Scarlet; and with Neville and Winther's acid, naphtol-sulphonic acid, 1 : 4, for Double Scarlet Extra; yet it was found that other combinations were feasible, and that among half a dozen other new derivatives, the best was that obtained when the Schoellkopf's was used. There a red was given which was very fast to the action of sunlight. Analysis proves the constitution to be—



|                 | Theory.       | Found.         |
|-----------------|---------------|----------------|
| Carbon, . . .   | 44.6 per cent | 44.4 per cent. |
| Hydrogen, . . . | 2.6 “         | 2.9 “          |
| Oxygen, . . .   | 29.7 “        | 29.4 “         |
| Nitrogen, . . . | 5.2 “         | 5.5 “          |

Of course, the dye when used is used in the form of its sodium salt. The specimen attached is numbered No. 1.

The next step in the research was the examination of Dahl's acid, betanaphthylamine-sulphonic acid,  $C_{10}H_6NH_2(2)SO_3H(5)$ . Dahl's is already used for some of the dyes in commerce at the present time. One of these is made by the linking of the diazotized Dahl's acid with Neville and Winther's acid, naphtholsulphonic acid, 1 : 4, for Pyrotin RRO. Several new dyes were brought out of this Dahl's acid: beta-Naphtol gave a red; naphthol-disulphonic acid, "G", 2 : 6 : 8, gave an orange; its isomeric modification "R", 2 : 3 : 6, gave a red; and then the Schœllkopf's, 1 : 4 : 8, gave the red which was the most resistant. This again pointed to the Schœllkopf's acid, as the most satisfactory to use, if fastness to light was desired. The compound produced by the Dahl's and Schœllkopf's had the proved constitution,  $C_{10}H_6(SO_3Na)N=N-C_{10}H_4(SO_3Na)_2.OH$ . A sample numbered No.  $3\frac{1}{2}$  is annexed.

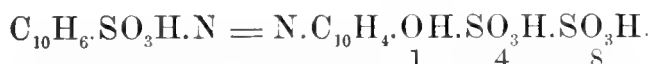
The writer took up next Naphthionic acid. And it gave some new derivatives, but again the Schœllkopf's acid was the best color from the standpoint of the solidity to the action of the sunlight. The sample of Naphthionic and Schœllkopf is numbered No. 4.

All this seemed to indicate that the Schœllkopf's acid had some very strong staying powers against light, and the Schœllkopf acid itself next became the object of investigation.

The Schœllkopf's acid has already been used for several dyes, patented by the Schœllkopf Aniline and Chemical Co., of Buffalo, N. Y. They are *Wool-Scarlet R*, where diazotized xyloidine is used with the Schœllkopf's acid; *Buffalo Rubin*, in which alpha-naphthylamine is applied; *Croceine B*, which is made from diazotized amido-benzene; and *Crocein 3B*, where amido-azo-toluol is utilized.

The experiments which had been made seemed to lead directly to the inference that when any naphthylamine-sulphonic acid was used with the Schœllkopf acid, a dye would result which would be fast to every common reagent. All the obtainable naphthylamine sulphonic acids were tried, and the results are appended. The weights used and the method is given here; the statement is for all the naphthylamine-sulphonic acids. Any naphthylamine-sulphonic acid, of the general formula,  $C_{10}H_6.NH_2.SO_3H$ , was taken, and 23.2 kilos. were weighed, dissolved in water, and diazotized with 7 kilos. of sodic nitrite and 12 kilos. of hydrochloric acid of twenty Baumé; then 25.4 kilos. of the Schœllkopf's acid, which had been previously

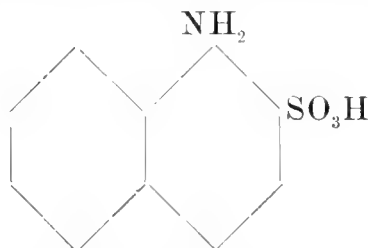
dissolved in water rendered alkaline by the addition of enough sodic hydrate to effect a solution, was added when the dye was immediately formed. The reaction could be facilitated by stirring, and by warming the solution to about eighty degrees C. The dye was salted out in the usual manner, filtered, pressed, dried, and analysed. All the dyes have the same elementary composition, and analysis gives the formula—



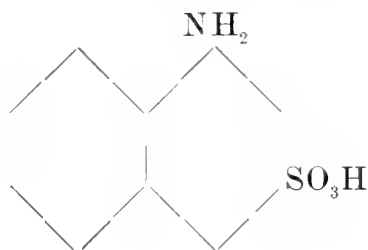
The dyes are reddish powders, readily soluble in water. Hydrochloric acid, even concentrated, produces no perceptible change in the color on the fibre; concentrated sulphuric acid on the dry powder shows a change to a pink of an eosine shade; the dyes are insoluble, as a rule, in alcohol, and are exceedingly fast to the action of sunlight.

The naphthylamine sulphonic acids which can be used are—

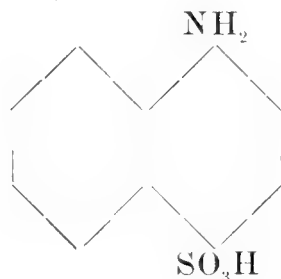
Alpha-Naphtylamine-sulphonic acid, 1 : 2, patent No. 56,563,



Cleve's alpha-Naphtylamine-sulphonic acid, 1 : 3,

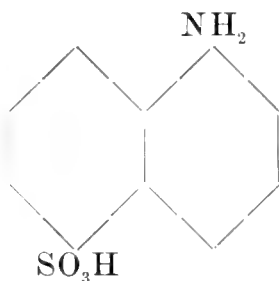


Naphthionic acid, 1 : 4,

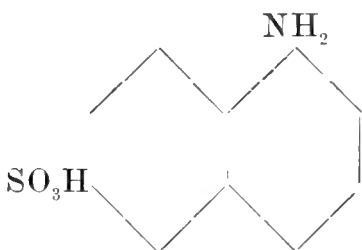




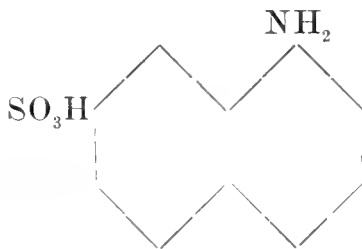
Alpha-Naphtylamine-sulphonic acid, 1 : 5,



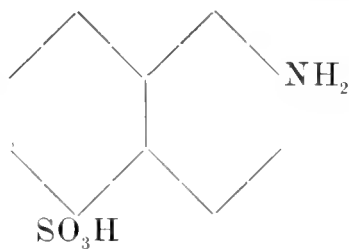
Alpha-Naphtylamine-sulphonic acid, 1 : 6. Bul. Soc. Chim. 26; 447,



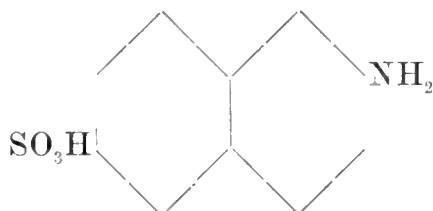
Alpha-Naphtylamine-sulphonic acid, 1 : 7. Ber. xxi, 3264,



Beta-Naphtylamine-sulphonic acid, 2 : 5, the so-called Dahl's acid,



Beta-Naphtylamine-sulphonic acid, 2 : 6, the so-called Bronner's acid,



The compound which appeals most strongly to the practical colorist was the derivative obtained when Bronner's and the Schœllkopf acid were joined. This dye was a red which had very remarkable powers of sustaining the prolonged action of the acids used in bleacheries; this gives the dye a commercial value which is not small; further, the dye was very resistant when exposed to the sunlight.

*Action of Bromine on the Dyes of the Azo Group.*

VI. This group of experiments was carried out with the desire of proving whether the presence of bromine in the dyes of the Azo Group was detrimental or not. The halogens are essential in the production of certain colors, namely, bromine in the production of Eosine from Fluoresceine, and Phloxine from di-chlor-fluoresceine; iodine in changing Fluoresceine to Erythrosine; and the di-chlor-fluoresceine to Rose Bengale. In general the results of the trials seem to indicate that bromine alters the color to the orange side of the red, and gives, as a rule, an undesirable hue.

The writer here wishes to express his sense of the many obligations he is under to Professor C. Loring Jackson, without whose encouragement and counsel the experiments would not have reached a successful termination.

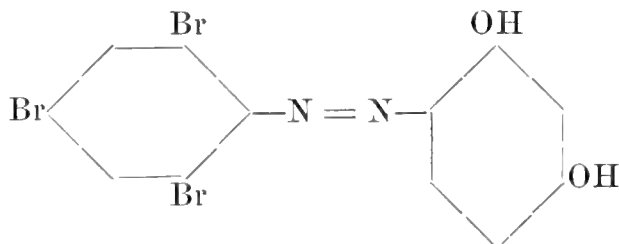
The experiments resolved themselves into the making of a series of chemically pure dyes, and then constructing analogous dyes, which carried bromine in the molecule.

The first dye manufactured was Sudan I, and the corresponding dye which was made with bromine was,



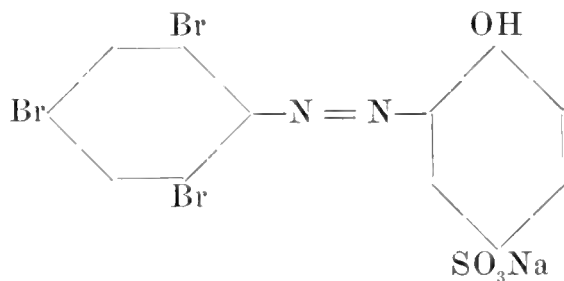
The two colors have the same formulæ, with the exception that one holds the three atoms of bromine. The dyes are readily made; in the case of the Sudan I, aniline is diazotized in the usual manner with sodic nitrite in an acid solution, and coupled with naphthol. For the bromated compound, tri-brom-aniline was made by drawing vapors of bromine through an acidulated solution of aniline hydrochloride, and the precipitated tri-brom-aniline was filtered off, washed, and dried. After diazotization, it was coupled with naphthol, and the dye immediately resulted. The colors are red and orange-red.

When resorcine was utilized, dyes were made of the formulæ,  
 $\text{C}_6\text{H}_5\text{.N}=\text{N.C}_6\text{H}_3(\text{OH})_2$  and  $\text{C}_6\text{H}_2\text{Br}_3\text{.N}=\text{N.C}_6\text{H}_3(\text{OH})_2$ ,  
 or written to show graphic constitution,



Another proof was furnished by these two dyes that the bromine was a detriment to clear colors, for the dye with the bromine in its make-up was thrown towards the orange hue again.

Another derivative which would show the difference between dyes holding bromine and those with no bromine in the constitution was the color made when diazotized aniline or tri-brom-aniline respectively, were treated with Neville and Winther's acid, alpha-naphtol-mono-sulphonic acid, 1 : 4. The bromine-holding dye gave the constitutional formula,



The commercial name of the dye without bromine is Tropäolin.

Dyes with the hydroxyl in the beta position were made with and also without bromine. These are the analogue of Crocein Orange or Ponceau 4GB. The formula of the bromated compound is,

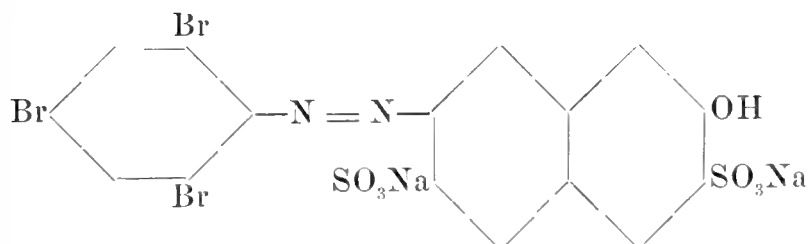


Further details do not seem to be requisite. The comparison of the two dyes, when purified and dyed on wool, show that the bromine flattens the shade.

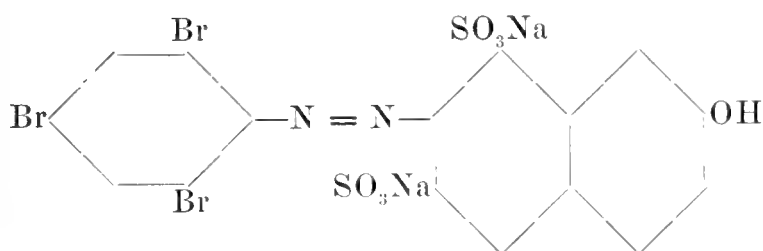
The isomeric beta-Naphtol-di-sulphonic acids, "R" and "G", were the next naphtol sulphonic acids which were utilized with the wish of giving another proof of the possibilities of bromine in the

molecule. The bromine-holding dyes had the following constitution:—

“ R ”



“ G ”



The dyes, when compared with their commercial relatives, Ponceau 2G and Orange G extra, have distinctly more orange hues.

Many other dyes were made, but it is deemed unnecessary to multiply instances. Some of this additional work may be mentioned however; when the diazotized tri-brom-aniline was linked with alpha-naphtol a brown-red was made; alpha-naphtylamine gave a red; beta-naphtylamine a brick-red; Bronner's gave a black-red; Dahl's a crimson; tri-sulphonic acid of naphtol a bright red, very soluble in water.

SCHOOL OF MINES, COLUMBIA COLLEGE, March 15, 1894.

## VII.—*A Classification of Lepidopterous Larvæ.*

BY HARRISON G. DYAR, S. B.

Read March 19, 1894.

In a recent paper<sup>1</sup> Professor J. H. Comstock has proposed a new classification of the Lepidoptera based on the methods of uniting the fore and hind wings, and on the modifications of the wing veins. It has occurred to me to review, in a general way, the arrangement and external structure of the setiferous tubercles of the larvæ of the Lepidoptera, to see how a classification based upon these structures would compare with this new classification. For, if the new classification is a natural one, it should be corroborated by a study of any set of organs, as Prof. Comstock points out; and it would seem that the tubercles of the larvæ are sufficiently different from the wing veins of the adult to make the test severe.

It is to be noted that the larvæ of the Lepidoptera, on the whole, live an exposed life, where they are subject to be preyed upon by enemies of various kinds, many of which use the sense of sight to find their victims. Therefore, it is not surprising to find these insects modified in all sorts of ways for concealment or defence, not only in color but in structure as well.<sup>2</sup> And the setiferous tubercles are among the most frequently modified structural elements. Moreover, this modification takes place, in part, independently of any corresponding change in the adult insect. And it may even be reasonable to suppose that where the larva is highly modified, we should find the adult in a generalized condition. This would result from the consideration that it might be advantageous to the insects in question to shorten the length of adult life and lengthen that of the well-adapted larva. So, if the adults had but a short time to live, it would be unimportant that specialization should take place. Hence it is not improbable that a classification

<sup>1</sup> Evolution and Taxonomy, Wilder Quarter Century Book, pp. 37-113.

<sup>2</sup> See E. B. Poulton's "Colors of Animals."

based on the larval tubercles might differ in important respects from one based on the adult insect. That this is not the case in the present instance for the major groups, shows that the classification proposed by Prof. Comstock is the nearest to a natural one that we have yet had. That it is frequently the case in the minor groups, illustrates the principle to which I have just referred. It is, moreover, a fact, that we see the greatest amount of modification in those larvæ which live the most exposed life, and whose period of larval existence is the most extended. Some of these cases will be specially alluded to.

#### GENERAL EXTERNAL STRUCTURE OF LEPIDOPTEROUS LARVÆ.

The body of the lepidopterous larva is divided into thirteen segments, three thoracic and ten abdominal.<sup>1</sup> The last two abdominal segments are closely united in most of the higher families, so to appear as one. On each of the third to sixth and tenth abdominal segments are a pair of fleshy legs, furnished with prehensile hooks. In special cases, certain of these legs are absent or modified for other uses; or, much more rarely, the three pair of jointed, chitinous, thoracic legs may be wanting. On each segment (when not too highly specialized) are certain, small, chitinous tubercles, arranged in a definite manner, each bearing a bristle or seta. The arrangement and modification of these tubercles is the subject of this paper. On the thoracic segments, the arrangement is different from that on the abdominal ones. For simplicity, we will confine attention principally to the latter, and to those segments of them which bear feet.

Since all lepidopterous larvæ periodically cast their skins (varying from three to ten times in different species) before the final molt to acquire the pupa stage, and since the external structure is not the same in each larval stage, it is necessary to consider at what stage the larval tubercles are to be compared. There are two types among the more highly specialized larvæ. In the first, represented by the Saturniidæ and Notodontidæ, the arrangement of tubercles

<sup>1</sup> Dr. A. T. Bruce remarks in the case of the embryonic *Thyridopteryx ephemæformis*: "It is questionable whether the terminal portion of the abdomen which forms the so-called eleventh abdominal somite is to be regarded as a true somite or not. It has no ganglion corresponding to it, and is formed . . . by the dorsal flexure of the posterior end of the embryo. . . ." (Observations on the embryology of insects and arachnids, p. 9, 1887.)

is the same in all stages. These larvæ rarely have more than five stages. In the second, represented by the Arctiidae and Lymantriidae, and by many Butterflies, the first larval stage is remarkably different from the following ones. In these embryonic larvæ, which have not passed a moult since leaving the egg, we find a generalized condition of the tubercles and setæ. I have concluded not to consider the larvæ in their first stage for this reason, the more so as it is doubtful if the character of the presence or absence of this generalized first stage has any special phylogenetic significance. It would seem, rather, to depend upon the necessity of shortening the larval stages, or upon the condition of the environment of the individual, which rendered it necessary for the little larva to come into active existence fully armed, as is the case with the newly hatched larvæ of *Heterocampa* and *Cerura* among the Notodontidae or with the Sphingidae. Others, with less necessity for an active struggle in very early life, have retained the primitive or generalized condition till the first molt.

#### THE ARRANGEMENT OF THE TUBERCLES.

There are two types of arrangement. The first, which is by far the more generalized, consists (considering only the abdominal segments) of five tubercles above the spiracle on each side, three in a transverse row about the middle of the segment and two behind; below the spiracle are two oblique rows, containing, respectively, two and four tubercles. This type is found in *Hepialus*, and is probably typical of the larvæ of the moths in Prof. Comstock's first suborder, the Jugatae.<sup>1</sup>

The second type contains two dissimilar lines of modification of the first type; but, as they agree in number of tubercles and in other characters, I will consider them together. The fundamental arrangement of the tubercles is as follows: On each side above the spiracle three tubercles; below, or behind the spiracle and above the base of the leg, three more; on the base of the leg three (or four) on the outside and one on the inside near the midventral line. These I propose to designate thus, counting from the dorsal line down the side: Tubercles i, ii, iii above the spiracle, iv, v, vi below it; the group of three on the outside of the leg as vii, and the single one on the inside of the leg as viii. Tubercles vii and viii are present

<sup>1</sup> I have not had *Micropteryx* for examination.

also on the legless abdominal segments (viz., segments 1, 2, 7, 8, and 9 of the abdomen) in the corresponding position. On the last two segments (segments 9 and 10) the number of tubercles is always less than the fundamental number, even in generalized larvæ. This is due to the fact that these segments have been partly aborted, being without spiracles. The reduction of segment 9 has taken place on the anterior portion, while segment 10 has lost the lateral part.<sup>1</sup>

#### PHYLOGENY OF THE TUBERCLES.

In comparing the larvæ of other orders of insects with the Lepidoptera, we find but few which throw any light on the origin of the present arrangement of the tubercles. The Phryganidæ, the imagos of which seem to suggest an affinity with the Lepidoptera, have larvæ without any tubercles, and also without any abdominal feet. They have, however, a dorsal shield on the mesothoracic segment, as well as on the prothoracic segment, a fact which is very interesting in connection with the structure of the Hepialidæ and Psychidæ.

In the larvæ of the phytophagous Hymenoptera (Tenthredinidæ) we find well-developed setiferous tubercles, apparently in a more generalized condition than in any Lepidoptera. They have the following arrangement (see Fig. 1): Above the spiracle nine tubercles

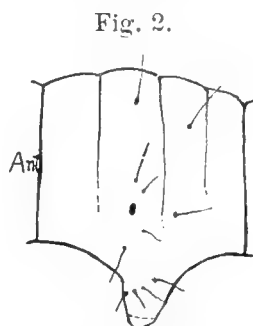
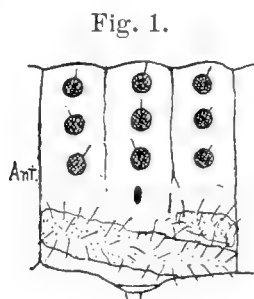


FIG. 1.—Diagram of a segment of a species of Tenthredinidæ (*Hylotma McLeayi*).

FIG. 2.—A segment of *Hepialus lupinulus* (from a drawing by Mrs. P. N. Knopf).

in a square, three on each of the fundamental subsegments or annulets. Below the spiracle is the substigmatal ridge, divided into two oblique portions, each thickly covered with setiferous tubercles.

We may homologize these with the Lepidoptera as follows: In the Jugatæ (see Fig. 2) the three tubercles of the middle annulet

<sup>1</sup> In the generalized Pyralid *Pantographa limata* G. & R., tubercles i and iii are lacking on segment 9, tubercles iv, v, and vi on segment 10.



are all present, and the upper and lower of the posterior annulet the two substigmatal tubercles may represent the substigmatal ridge of the Tenthredinidæ. The others have no homologue in these Hymenoptera.

In the Frenatæ we have the same arrangement still further reduced. But here appears an important difference to which I have alluded above. In the Psychidæ the three tubercles are retained on the middle annulet, while both are lost on the posterior one (see Fig. 3); the substigmatal tubercles are retained and approximated; the *anterior* one of the four on base of the leg seems to have been moved up, forming tubercle vi, which is thus anterior. In the other type, which includes all the other families of the

Fig. 3.

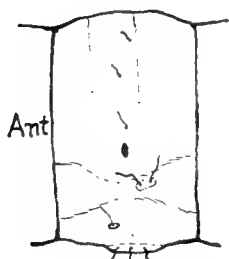


Fig. 4.

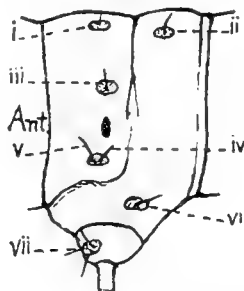


Fig. 5.

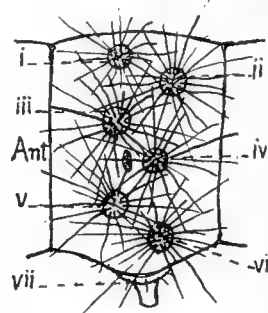


FIG. 3.—Segment of an undescribed Psychid larva from New Mexico.

FIG. 4.—Segment of *Margarodia quadristigmatis* (from figure in *Insect Life*, vol. I, p. 24, with addition of setæ).

FIG. 5.—Arctian type of tubercles (diagram).

Frenatæ, the middle tubercle of the three on the middle annulet is lost, but the upper on the posterior annulet is retained; the two below the spiracle are retained also, as in the Psychidæ; but they are either approximated (see Fig. 4) or separated (see Fig. 5), giving us characters for the next subdivision. Of the four tubercles above the base of leg, the *posterior* one is moved up, forming tubercle vi. These two types must represent dichotomous lines of descent. If this is true, the Psychidæ should be separated from the other Frenatæ as a great group, equal in rank to all that follow.<sup>1</sup>

<sup>1</sup> This can be done, in most cases, also by characters of venation; viz., the permanent cross vein in the Psychidæ between veins viii and ix on primaries, which exists also in the Hepialidæ, and to which more classificatory importance can be attached than has been done by Prof. Comstock.

#### MODIFICATION OF THE TUBERCLES.

The primitive form of tubercle consists of a little chitinous button on the skin bearing a single long hair. It is found in the less specialized families of all the groups discussed above, and exclusively in the Jugatæ and in the Psychidæ. When this form is present, there are, in general, no other hairs on the body.

The Frenatæ, exclusive of the Psychidæ, may be divided into groups on the character of the tendency to coalescence or separation of tubercles iv and v, as I have remarked above. The first group corresponds to Prof. Comstock's division of "Microfrenatæ" and "Generalized Frenulum Conservers," plus one family each from his Zygænina and Saturnina.<sup>1</sup> The second group corresponds to his "Specialized Frenulum Conservers" and "Frenulum Losers" with the exceptions just noted. If we shift the order of Prof. Comstock's characters, and disregard the two exceptions, we may say that the first group corresponds to the *Generalized Frenatæ*, the second to the *Specialized Frenatæ*. Now, in the lower families of these two groups, we have the primitive form of tubercles, as already stated. In the higher families of both groups we have at first a parallel line of modification, which consists in the tubercles becoming enlarged and many haired. Each hair arises from its own minute tubercle, and the whole are borne upon an enlarged base or wart.<sup>2</sup> The arrangement of the warts is, at first, strictly that of the primitive tubercles, and they correspond in number and equality of development. The next step is a reduction in the number of tubercles, by unequal development and final obliteration of certain ones. In the higher Generalized Frenatæ, tubercle iv has disappeared by coalescence with v, and in the higher Specialized Frenatæ it becomes

<sup>1</sup> Prof. Comstock informs me in correspondence that he has somewhat changed his views in regard to these two latter superfamilies, so that he will place them more in accordance with my own view, derived from studies on the larvæ. I omit reference to the Sesiidæ, which Prof. Comstock places among the specialized frenulum conservers, as he states in the text of "Evolution and Taxonomy," that they probably belong with the Microfrenatæ, a conclusion which is abundantly justified by larval characters.

<sup>2</sup> It is a striking fact that we do not find a series of intergrading forms between the single-haired tubercle and the many-haired wart, though both may occur in different genera of the same family. This can be understood on the principle of discontinuous variation which is insisted upon by Bateson ("Materials for the study of variation").

smaller till it disappears, as may be seen in certain genera of the Lymantriidæ. This obliterates the fundamental distinction that I have drawn between these groups. The distinction is still equally good theoretically; but it fails in practice. For this reason I have been in doubt about the position of the Pyromorphidæ, Megalopygidæ (= Lagoidæ), and Eucleidæ (= Limacodidæ), and I have been obliged to give weight to the characters of the moths in locating these families. It is to be noted that the characters drawn from the tubercles do not contradict the position which I have assigned to these families, and I believe that I have correctly pointed out the reason why the character of the tubercles fails.

Several lines may now be taken by the increasing specialization. The tubercles may entirely disappear, either leaving the skin smooth, or the whole body covered with pile or soft hair. The bases of the tubercles may persist and be produced into fleshy processes, often of great length, while the setæ become aborted as we see in certain Nymphalidæ and Papilionidæ; or the setæ may remain, and, becoming glandular,<sup>1</sup> secrete a poisonous, urticating fluid as in the Megalopygidæ and Eucleidæ. Again, we may have the hairs greatly complicated, developed into brushes, tufts, and plumes, or finely feathered at the tips as in the higher Arctiidæ, the Lymantriidæ, and Euchromiidæ (= Zygænidæ of Kirby's catalogue).

Perhaps the highest degree of modification exists in certain forms in which the tubercles are partly retained, but tubercle i of each side, approaching the dorsal line, has become consolidated with its fellow of the opposite side, producing a row of dorsal tubercles apparently unpaired. This seems to have taken place in two separate lines of descent, and in a manner not quite parallel in the two. In the first, namely that of the Saturnina (except the Lacosomidæ) and the Sphingidæ, we have tubercles i consolidated dorsally on abdominal segment 8, while ii are similarly consolidated on segment 9, tubercle i being absent on the other segments. In the second line, which consists of a part of the Nymphalidæ, tubercle i is retained on all the segments, and we have a row of single dorsal tubercles on abdominal segments 1 to 8 inclusive, without indication of a consolidation of ii on the 9th segment.<sup>2</sup> In both these groups, a further modification of the tubercles is undergone, in that the

<sup>1</sup> Perhaps the primitive seta is glandular. See Dr. A. S. Packard's many papers on the glandular setæ of young larvæ.

<sup>2</sup> In some species, as *Heliconia charitonia* and *Argynnis diana*, this now is absent

base is prolonged and chitinized, thus converting the tubercles into large branching processes, each branch tipped with a hair. In the Sphingidæ it appears that all the tubercles have disappeared except the dorsal one on the 8th segment, which forms the well-known "caudal horn." In some of the Saturnina, we have the setæ modified into urticating spines as in the case of the Eucleidæ. This similarity does not imply relationship as Dr. A. S. Packard seems to believe,<sup>1</sup> since we have only a similarity in function, while the structure of the bases of the tubercles is essentially different.

#### ON THE MATERIAL USED.

In the latest list of North American Lepidoptera<sup>2</sup> there are enumerated sixty-three families, eliminating a few which have since been united with others. I have found it impossible to obtain the necessary material to make observations on all of these. Especially in the group Tineina, which contains nineteen families, my material has been very scant. I have not been able to avail myself of the numerous descriptions of lepidopterous larvæ scattered in various journals, and only to a small extent of published figures, since the former have been drawn up without any reference to the arrangement of the tubercles, while the latter are (with a few notable exceptions), either without accuracy or drawn in such positions that it is impossible to determine the arrangement of these structures. I have not considered families which occur exclusively outside of North America, on account of the total lack of material.

I am indebted especially to Professor J. H. Comstock for many alcoholic specimens, and to Dr. A. S. Packard for the loan of several which I would not otherwise have seen.

#### THE CLASSIFICATION OF THE LEPIDOPTERA.

Before proceeding to a detailed description of the tubercles of the various species which I have examined, a few general remarks are in order. I have already indicated how well the present classification drawn from the characters of the tubercles of the larva corresponds with Prof. Comstock's classification from the venation of the adult. The essential feature in which this classification differs

<sup>1</sup> See Journal N. Y. Entomol. Soc., vol. I, p. 9.

<sup>2</sup> List Lep. Boreal Amer., J. B. Smith, 1891.

from all heretofore proposed, namely, the division into Jugatæ and Frenatæ is abundantly sustained.<sup>1</sup> The divisions of the Frenatæ are not strictly sustained; but the general idea holds good, of generalized and specialized Frenatæ. More than this we seem to have two lines of descent indicated by these terms. I have not found full justification of Prof. Comstock's further division of the Specialized Frenatæ into "Frenulum conservers" and "Frenulum losers." In fact, the use of these characters as a division of the Specialized Frenatæ is not sustained by a study of the larvæ. The loss of the frenulum is rather to be considered as a secondary adaption for flight with broad wings, and it has arisen separately in several distinct lines of descent.

The two points in which my classification contradicts that of Prof. Comstock now require attention.

1. *Superfamily Zygænidæ*.—So far as the North American fauna is concerned there are but two families which claim notice, the Euechiidæ and Pyromorphidæ. According to my views, these belong to the two separate lines of descent, the specialized frenatæ and generalized frenatæ respectively. I will not do more here than call attention to this difference, as the Pyromorphidæ are one of the families about which I have been in doubt.

2. *The Family Lacosomidæ*.—This is placed among the Saturnina by Prof. Comstock, but from larval characters it belongs with the generalized frenatæ. It is true that the moths bear a close resemblance to the Saturnina; but I believe that this will be found to be fortuitous. I regard it as an instance where specialization has taken the same form in different lines of descent, and has led to a misinterpretation of the characters. The larvæ have retained a generalized condition on account of their secluded life, and give us truer characters for the classification of the family. It is a case the converse of that of the Euleidæ, where specialization has taken place in the larva, and where the generalized adult gives the best indication of the relationship of these curious insects.

To show how completely my classification of the larvæ contradicts the generally accepted classification of Lepidoptera, it is only necessary to briefly consider the "Superfamily Bombyces." No one has prepared a satisfactory definition of this group so far as I

<sup>1</sup> This same division of the Lepidoptera has been made by G. F. Hampson (*Fauna of British India: Moths*, vol. I, p. 8), but apparently without recognition of the real distinctive character.

am aware, and it has been stated that it could not be defined.<sup>1</sup> Nevertheless, Dr. Packard has very recently prepared a list of the families of the Bombyces,<sup>2</sup> following in the main the old lines. It is only necessary to compare his list with the following synopsis of families to show how completely at variance the two systems are. In fact, a more miscellaneous aggregation of families could not well be imagined than the so-called "Bombyces," judged by the standard of my classification of the larvæ.<sup>3</sup>

SYNOPSIS OF THE FAMILIES OF LEPIDOPTEROUS LARVÆ.<sup>4</sup>

- A More than one tubercle on the third annulet and more than six above the base of leg.....**Jugatæ**  
**Hepialidæ**
- AA Not more than one tubercle on third annulet and only six above the base of leg .....**Frenatæ**
- B Three tubercles on middle annulet, none on the third; tubercles iv and v approximate; two thoracic shields.....**Psychidæ**
- BB Not more than two tubercles on middle annulet and usually one on third annulet; one thoracic shield (prothoracic).
- C Tubercles iv and v approximate or consolidated.  
GENERALIZED FRENATÆ
- D Tubercles simple, single haired .....**Cossidæ, Pyralidina,**  
**Tortricina, Tineina** (in part), **Lacosomidæ, Sesiidæ**
- DD Tubercles absent, as well as all legs .....**Tineina** (in part)
- DDD Tubercles modified, many haired.
- E All present but tubercle i.....**Pterophoridæ**
- EE Subventral tubercles also reduced; only three left.  
**Pyromorphidæ, Megalopygidæ**
- EEE Substigmatal tubercle absent; only two left.....**Eucleidæ**
- CC Tubercles iv and v remote<sup>5</sup>.....SPECIALIZED FRENATÆ
- F Tubercles all present or with but slight tendency to unequal reduction, setiferous, or equally reduced.

<sup>1</sup> J. B. Smith, List Lep. Bor. Amer., p. iv; Neumøgen & Dyar, Journ. N. Y. Ent. Soc., I, 97.

<sup>2</sup> Journ. N. Y. Ent. Soc., I, 6 (1893).

<sup>3</sup> "The family *Bombycidæ* would certainly never have been formed if the larval structure only had been taken into consideration. . . . Are the imagines of the genera united under this family, at any rate morphologically, as unequally related as their larvæ?" Weismann, Studies in the Theory of Descent, vol. II, p. 442.

<sup>4</sup> Families which have been omitted have not been examined.

<sup>5</sup> In the higher forms, where the tubercles begin to be lost, iv may disappear, leaving the remaining tubercles in essentially the same arrangement as those in the section above, where the consolidation of iv and v is complete, and where vii has disappeared.

- G Simple, with a single seta ..... **Noctuidæ** (in part), **Agaristidæ**,  
**Notodontidæ**, **Geometridæ**, **Drepanidæ**,  
**Lithosiidæ** (in part)
- GG Tubercles with many hairs.
- H Without any development of hairs from the skin.  
**Noctuidæ** (in part), **Pericopidæ**, **Arctiidæ**,  
**Euchromiidæ** (= **Zygænidæ**), **Lymantriidæ**
- HH Tubercles greatly reduced; abundant hair from the skin.  
**Lasiocampidæ**
- FF Tubercles with marked unequal reduction, or greatly modified or absent.
- I Tubercles still wart-like, hairy.<sup>1</sup>  
**Lithosiidæ** (in part), **Lycænidæ** (in part)
- II Tubercles greatly modified or absent.
- J Tubercle i normal (when present). .
- K Tubercles produced into naked fleshy horns, or represented by colored spots ..... **Papilionidæ**, **Nymphalidæ** (in part)
- KK No trace of tubercles..... **Nymphalidæ** (in part),  
**Pieridæ**, **Hesperidæ**
- JJ Tubercle i consolidated with its fellow on the dorsum.
- L No unpaired dorsal tubercle anterior to abdominal segment 8.
- M Tubercles largely present ..... **Saturnina**
- MM Only the dorsal tubercle on segment 8 ..... **Sphingidæ**
- LL A line of unpaired dorsal tubercles the length of the abdomen anterior to segment 8, or largely so.  
**Nymphalidæ** (in part)

#### Suborder **Jugatæ.**

##### Family **Hepialidæ.**

Very little is known about the larvæ of our native species. D. S. Kellicott has described *Stenopsis argenteomaculata*,<sup>2</sup> and this is the only one of our species of which the larva is known. Unfortunately the description is inadequate for my purpose. I infer from it, however, that the larva has the setæ single and possesses a dorsal shield on the mesothoracic segment as well as on the prothoracic and the anal (10th abdominal segment). See Fig. 2 for illustration of an European species.

#### Suborder **Frenatæ.**

##### The isolated Family **Psychidæ.**

This family seems to be equal in rank to all that follow, taken together. I have already alluded to the presence of a dorsal shield

<sup>1</sup> The young larvæ of many Papilionidæ will also come in here.

<sup>2</sup> Insect Life, vol. I, p. 251 (1889).

on the mesothoracic segment. The retention of this primitive character corroborates the above conclusion. The family must be of great age, and the wide distribution of its members, which are found in all quarters of the globe, confirms this view. It is the only family of Lepidoptera in which the females of all the species are wingless, and they are probably the most degenerate of all such females. I have examined three larvæ.

***Oiketicus kirbyi* Guilding.**

Mr. B. Neumøgen has given me a number of specimens received from a collector in Guadalajara, Mexico. In this species, as in all the others, the setæ are very fine and difficult to determine, while the tubercles have almost disappeared. The arrangement is that of my Fig. 3, though I could make out but two hairs on the base of the leg.

***Oiketicus townsendi* Riley MS.**

This is the species shown in Fig. 3, which I have received from Mr. T. D. A. Cockerell, of Las Cruces, N. M. The U. S. government entomologist has attached the above name to it, I am informed. It is to be hoped that Dr. Riley will soon give us an account of it. Judging from the larval case, I have doubt about the propriety of the reference to the genus *Oiketicus*.

***Thyridopteryx ephemeræformis* Stephens.**

I have examined a specimen prepared by Mr. Wm. Beutenmüller. The setæ are very obscure, and I could not make out any below tubercle v. There is a circular corneous plate behind tubercle iii, another bears tubercles iv and v, and there is a third one corresponding in position to tubercle vi.

THE GENERALIZED FRENATÆ OR MICROLEPIDOPTERA.

The term Microlepidoptera may be retained for these families, though several are included which were formerly classed among the Macrolepidoptera.

The modification of the primitive arrangement of the tubercles begins in the tendency to consolidation of iv and v. Tubercles i and ii are more nearly in line than they are in any of the Specialized Frenatæ, and vii is developed into a distinct wart on the bases of the legs, compensating for the absence of leg plates in this group.



Thus there appear to be two subventral tubercles, the upper *posterior*, the lower *anterior*.

There are two lines of specialization. The first consists in the loss of all the tubercles as well as the feet, even of the thoracic ones. This is seen in certain Tineids (e. g., *Antispila nyssæfoliella*), which are adapted to living in mines between the two surfaces of a leaf. The second line occurs in larvæ living an exposed life. It begins in the multiplication of the hairs of the tubercles and the conversion of them into warts, exactly as in the Specialized Frenatæ. Closely following on this comes the reduction in the number of tubercles. This is seen in the Pterophoridaæ, where tubercle i has disappeared. Next we have the reduction and disappearance of the subventral tubercles, leaving but three, two above the spiracle and one below. This is probably in adaption to the form of the larva, which is now becoming flattened with shortening of the abdominal legs. The Pyromorphidæ and Megalopygidæ are in this condition. Following this stage, the substigmatal tubercles (tubercles iv and v) disappear, and the flattening of the ventral region reaches its extreme. The hairs of the tubercles have also been gradually converted into stinging spines. In the Megalopygidæ they are only partially converted; but in the Eucleidæ the conversion is complete, and we have, finally, the highest type of the Microlepidoptera, and, perhaps, the most highly modified larva of all Lepidoptera. It is interesting to note that the moths of the Eucleidæ are much more generalized than those of several of the families which precede them, while the larvæ are so highly specialized. This illustrates the principle to which I alluded at the beginning of this paper, that specialization in the larva may be accompanied by a generalized condition of the moth. It is notorious that the larvæ of the Eucleidæ live for an usually long period.

#### Family Cossidæ.

##### ***Zeuzera pyrina* Linnæus.**

Mr. J. Doll has kindly obtained for me some larvæ of this species, recently renamed *Z. decipiens*<sup>1</sup> by Mr. W. F. Kirby, of the British Museum, on the supposition that our species is not the same as the European. The setæ arise from the centre of round black spots, i, ii, and iii in the normal arrangement. In front of the spiracle is a small black spot, suggesting a tubercle, but it bears no seta; iv and v arise from a single spot, and below them posteriorly is vi;

<sup>1</sup> Catalogue of Lepid. Heterocera, vol. I, p. 871 (1892).

vii consists of three setæ near the foot, and viii a single one on the inside of the leg. There is a large dorsal prothoracic shield, but no trace of a mesothoracic one.

Superfamily **PYRALIDINA.**

Family **Pyraustidæ.**

**Mecyna reversalis** Guenée.

The setæ arise from the centre of large black patches, except vii the tubercles of which are separated considerably; viii has also a black patch; iv and v are approximate but not consolidated. The tubercles are distinct, but the setæ are much aborted, so that at first glance the small supplementary white spots bordering the black patches suggest the location of these structures. Larva received from Prof. Comstock.

**Pantographa limata** Grote and Robinson.

In this larva there are no colored markings. The tubercles are situated on rounded corneous areas, and are without setæ, except in the subventral region. Tubercle i is situated in the lower posterior corner of its corneous area, and there is a distinct dark dot in the opposite corner, suggesting a duplication of this tubercle. Tubercles iv and v are approximate, iv on the upper posterior corner of the area which bears v. The first annulet is not well marked; the fold behind the second is distinct, and the third annulet is divided by an oblique fold running posterior to tubercle ii. This produces an arrangement seen in very many of the Microlepidoptera where the segment is divided into three annulets differing from the primitive ones.

Family **Galleriidæ.**

**Galleria mellonella** Linnæus.

The larva is without marks, its tubercles very minute and without corneous areas, though they bear distinct setæ. The abdominal feet are very short, but bear tubercles vii and viii in the normal manner. Tubercles iv and v, and the three composing vii are approximated, but unconsolidated.

Family **Phycitidæ.**

**Vitula edmandsii** Packard.

The tubercles are small, dark, and bear pale setæ. Tubercles iv and v are consolidated, the two setæ arising close together; the

tubercle on the base of the leg (vii) is very weak, the hairs being separated and obscure. The segments are divided into two annulets, corresponding to the two posterior ones of the *Tenthredinidæ*.

***Plodia interpunctella* Hübner.**

The setæ are very fine and the tubercles minute; both have nearly disappeared, except that the subventral ones bear distinct hairs. The arrangement of tubercles is the same as above, though I cannot positively distinguish more than one seta from tubercle v. Perhaps the other has disappeared.

Superfamily **TORTRICINA.**

Family **Grapholithidæ.**

***Carpocapsa pomonella* Linnæus.**

The setæ are distinct and the tubercles are surrounded by corneous areas. Tubercles iv and v arise from the same area, while the setæ of vii, three in number, are without a corneous area. The other tubercles are single, normal.

Family **Tortricidæ.**

***Cacœcia cerasivorana* Fitch.**

The tubercles are quite large, having apparently occupied most of their surrounding corneous areas, and suggest to us the origin of the warts of the *Pterophoridæ*, though the setæ are not increased in number. Tubercles iv and v are consolidated into a single wart. The large prothoracic dorsal shield is very distinct.

***Lophoderus politana* Haworth.**

The setæ are distinct, but the tubercles obscure. Tubercles iv and v are not very closely consolidated. The arrangement is quite normal. In all these larvæ we note that the 9th and 10th segments of the abdomen are separated by a well-marked division.

Superfamily **TINEINA.**

In this group we reach the highest degree of modification in the line of abortion of tubercles, setæ, and other normal body structures. Here specialization has taken the course of degeneration. Since we have at least four different lines of descent among the Generalized frenulum conservers, I cannot arrange the families in a satisfactory

serial order. Strictly the Tineina larvæ are more specialized than those of the two next families, and should follow them.

Family **Gelechiidæ**.

**Depressaria heracliæna** DeGeer.

The tubercles are situated in large, polished, black corneous areas, and the setæ are aborted, except subventrally. The arrangement is normal; iv and v are closely approximated, and arise from a single area, while the setæ of vii are gathered together on a single black area, forming a rather distinct wart. There is a single cervical shield, and a distinct suture between abdominal segments 9 and 10

Family **Elachistidæ**.

**Antispila nyssæfoliella** Clemens.<sup>1</sup>

There is a single cervical shield, a small projecting anal plate, and the body is flattened. A few setæ remain subventrally, but the tubercles have disappeared, as have also all the feet.

Family **Lacosomidæ**.

In 1893<sup>2</sup> I attempted to show that this group must be separated from the Psychidæ and the Drepanidæ, with both of which it had previously been united. I was unaware at the time that C. Plötz<sup>3</sup> had already established the family under the name Perophoridæ; but the name is preoccupied. A little later Dr. Packard<sup>4</sup> recognized this difference so far as to create a subfamily of the Psychidæ, where he transformed my term into Lacosominæ. In the same year (1893) Prof. Comstock's article appeared, in which the Lacosomidæ (= Perophoridæ) are included among the Saturnina, in the highly specialized group of Frenulum Losers. I had never seen the larvæ; but, through the kindness of Dr. Packard, I have now been able to examine both of our species, and Prof. Comstock has given me a Brazilian form. From these larvæ I conclude that this family belongs to the Microlepidoptera, as here set forth, a conclusion which is contrary to any previously offered.

<sup>1</sup> Dr. J. A. Lintner has kindly determined this larva for me.

<sup>2</sup> Entom. News, IV, 36.

<sup>3</sup> System der Schmetterlinge (1885).

<sup>4</sup> Journ. N. Y. Ent. Soc., I, 8.

***Cicinnus melsheimeri* Harris.**

A single cervical shield; body granular; feet normal, the abdominal ones very short. Spiracle on 8th abdominal segment higher up than the others. Anal plate very large, covering the feet, continuous with a hardened area on the posterior part of the 8th segment, bounded in front by a transverse elevated fold. Setæ fine, short, very obscure so that their position could not be accurately determined; but apparently as in the following:—

***Lacosoma chiridota* Grote.**

A single cervical shield, but its distinctive coloration extends back on the posterior thoracic segments; feet normal, the anal plate scarcely enlarged. Body smooth, the setæ arising from distinct tubercles; i anteriorly, ii posteriorly, only a little below i, iii superstigmatal, a little anterior, iv and v in line subventrally, vi above base of leg, vii consisting of several hairs on the base of leg, and viii single, distinct on the apodal segments.

Family **Sesiidæ.**

The Sesiidæ (= *Ægeriidæ*) have usually been classified next to the Sphingidæ, and this course is still followed by Dr. Packard. Less conservative authors have reached the conclusion that this is erroneous, and Mr. W. F. Kirby has omitted the family from his "Catalogue of Sphinges and Bombyces." A study of the larvæ fully confirms this view, and I would place the family among the Microlepidoptera. Prof. Comstock has kindly given me four larvæ.

***Sannina exitiosa* Say.**

The tubercles are very small, but distinct, and all bear setæ. Tubercles iv and v are closely approximated, one being situated immediately above the other. There are two distinct substigmatal folds or ridges, each with two corneous patches. On the upper one, iv and v are in the anterior patch, and on the lower vi is in the posterior patch. The three tubercles of vii are on the anterior side of the base of the leg. Segments strongly folded, biannulate. A distinct suture between segments 9 and 10.

***Harmonia pini* Kellicott.**

In this species the setæ are much reduced, but the tubercles have large, conical, corneous bases, so that they suggest low warts. Iv and v are on the same elevation, and the three tubercles of vii are in an oblique row as in the Hepialidæ. The larva is, otherwise, very similar to the preceding.

**Sesia tipuliformis** Linnæus.

The tubercles are small and the setæ fine, arising from slight corneous elevations. There is an elevation just behind the spiracle, and two others on the substigmatal folds, without setæ, while tubercle iv is very minute, though situated on the same elevation with v. The general arrangement is somewhat deceptive at first sight, especially owing to the minuteness of some of the tubercles.

**Melittia ceto** Westwood.

The tubercles are very small and obscure. In fact most of them seem to have disappeared. I was able to locate the position of i and ii, and there are traces of the corneous areas which the others occupied; but they are all very degenerate. The larva is plump and smooth, without any distinct annulets on the segments.

Family **Pterophoridæ**.<sup>1</sup>

We now come to a new line of modification, where the tubercles have become converted into many haired warts. I could not obtain any larvæ of this family, and my old notes are not sufficiently full, though they indicate the conclusions expressed in my synopsis. A careful study of this family would be full of interest, and I hope to be able to make it.

Family **Pyromorphidæ**.<sup>2</sup>

I take the following from my notes. It shows essentially the same structure as in the two following families, though we have no poisonous spines and the feet are normal.

<sup>1</sup> Mrs. Knopf has examined and sent me sketches of the tubercles of the larvæ of three European species, with the kind assistance of Mr. G. A. Poujade, of the Natural History Museum of Paris. In all the species there are single setæ only, without any development of warts, and in two they are all very degenerate. In the third, *Leioptilus scarodactylus* Hübn., the setæ are all quite well developed, and tubercle i is wanting, as in the American form with warts, referred to above.

<sup>2</sup> The European family Anthroceridæ, Kirby =(Zygænidæ of authors), should come just before the Pyromorphidæ. I have examined the larva of *Anthroceræ filipendule*. The tubercles are converted into warts, but the warts are greatly reduced, being represented by tufts of short hairs. Tubercle i is absent, iv and v are consolidated, and vii is very distinct on the base of the leg. Here we have direct evidence of the continuity of this series of families with the ancestors of the Pterophoridæ and allies.

**Harrisina americana** Harris.

Head retracted and concealed beneath the prothoracic segment. Body flattened, sides nearly perpendicular with a distinct substigmatal ridge. Four rows of low, flattened areas, representing warts, granular, and bearing numerous, radiating, short, fine bristles, and a few longer whitish hairs from the extremities of the body. Tubercles arranged (1) subdorsal, (2) lateral, (3) substigmatal, and (4) obscure, above the base of the leg.

Family **Megalopygidæ**.

The arrangement of the tubercles is the same as in the Pyromorphidæ. The two additional pairs of abdominal feet, unique in this family, have long been known. They were carefully described by J. C. Sepp in 1830<sup>1</sup> in the case of *Megalopyge xanthopasa* and *M. lanata*, and have recently been noticed by several authors. In the case of our native species, *M. crispata*, Dr. Packard, in a recent paper<sup>2</sup> gives a general summary of these structures with some excellent figures. He concludes thus: As to *Megalopyge* "with its rudimentary abdominal legs of the 2d and 7th segments of the hind body, we feel warranted, in the present state of the subject, in concluding that they may represent a persistent condition of two pair of these deciduous abdominal legs" (which appear in embryonic development). From this assumption he very naturally concludes that *Megalopyge* "in respect to its abdominal legs, even if we do not take into account other characters, is a survivor of an ancient and very generalized type, and represents, as no other known caterpillar, the polypodous ancestor of all Lepidoptera." Of course this conclusion is entirely opposed to my view of the relationship of the Megalopygidæ, and I cannot accept Dr. Packard's assumption. I regard the development of these additional abdominal feet as secondary. This family distinctly leads up to the Eucleidæ, and this structure shows us how they probably derived their peculiar mode of progression; for an extension of the modification of the ventral surface which has here begun, would give us the slug-like structure of the Eucleidæ, the most remarkable of all Lepidopterous larvæ.<sup>3</sup>

<sup>1</sup> Surinaamsche Vlinders, vol. I, expl. to pl. 14.

<sup>2</sup> Proceedings Amer. Philos. Soc., vol. XXXII, pp. 275-292.

<sup>3</sup> Dr. Packard has stated in several publications that the Eucleidæ (= Limacodidæ = Cochliopodidæ) have no thoracic feet. This is an error; the feet are distinctly present, though small.

Family **Eucleidæ**.

In the most generalized forms we have only two rows of tubercles present, the subdorsal and superstigmatal; the substigmatal row seen in the two preceding families having here disappeared. But there are two very different lines of modification in the family. In the first the tubercles are retained and prolonged into fleshy horns, while the setæ have been modified into poisonous urticating spines. This is accompanied by the development of bright and gaudy warning colors. In the second line, the tubercles tend to become reduced or entirely disappear, leaving the body smooth, and either colored plain green or ornamented with certain other colors designed for concealment.

I will describe these larvæ in detail.

## FIRST GROUP.

**Adoneta spinuloides** Clemens.

Head retracted under and folded in joint 2,<sup>1</sup> joint 2 partly under 3. Head green, jaws brown, eyes black. Body flattened, rather elongate, the sides nearly perpendicular, but not high, the back flat, of nearly uniform width, but narrowed toward head and rather more so towards tail. Dorsum at joint 3, 2 mm. wide, at joint 7, 3 mm., at joint 12, 2 mm. Lateral region has two rows of irregularly elliptical depressions, between which the body is somewhat ridged with a row of rounded elevations bearing minute spines. They are situated just below the spiracle on joints 3, 4, 6 to 12. Color green, covered with minute transparent granulations. The dorsal region is nearly smooth, the sunken places being represented by small, rounded whitish spots. On each side is a subdorsal row of spinose tubercles, one on each segment 3-13 inclusive, those on joints 3, 4, 5, and 12 longer than the others and colored bright red, those on joint 11 just tipped with red. Dorsal region yellow, containing a broad purple band edged with crimson, of irregular outline. It nearly covers the yellow on joints 3-5, being indented at each pair of tubercles; on 6 and 7 it is much enlarged; contracted at 8, almost to a line; enlarged again at 9 and 10; contracted at 11 and ends in a rounded enlargement on 12. It is divided by a pale dorsal line.

<sup>1</sup> For brevity, in these descriptions, I use the terms common among Lepidopterists, counting the head as "joint 1."



Length of larva 11 mm.; width 4 mm. Thoracic feet very small, pointed, green, tipped with brown. Abdominal feet absent, the whole ventral region flexible and sticky.

**Euclea indetermina** Boisduval.

Head below joint 2, 2 below 3; thoracic feet small, pale; abdominal none, venter soft and sticky, clear honey-brown. Dorsum and sides flattened with subdorsal and stigmatal series of segmentary horn-like processes, covered thickly with urticating spines. Subdorsal horns on joints 3 to 13, those on 4, 5, 8, 11, and 12 very long, the ones on 3 and 13 moderate, the rest very short, subspherical. Stigmatal row on 3, 4, 6 to 12, short, except the one on 4 which is twice as long as the others. Spiracles round, the one on joint 5 in line with the horns, those on 6 to 12 much below them, the one on 2 usually concealed as the segment is retracted. Head pale, blotched with red on its lower part; ocelli and mouth dark. Joint 2 granular, honey-brown. Body (A) lemon-yellow or (B) straw color, the tubercles (A) yellow, tinged with orange on 3, 6, 7, 9 and 10, or (B) vermillion-red with a red band along the subdorsal line, laterally, along the superstigmatal horns, and along subventral edge. Four narrow, dark purple lines in dorsal space, on a bluish-white ground, the two central ones parallel, the outer undulating to correspond with the locations of the larger horns. Four similar lines in lateral space separated into two pairs by a (A) yellow or (B) vermillion band, only slightly undulating. A similar single pair of lines enclosing the spiracles, the one below them the most distinct and separated from the sticky venter by a (A) yellow or (B) vermillion band. On 13, close behind the superstigmatal horn on 12, is a depressed pale area with purple border. Anterior edge of 3 purplish. Size  $18 \times 7$  mm. Horns on joint 8, 2.5 to 4 mm. in different larvæ.

**Euclea delphinii** Boisduval.

Elliptical; dorsal region flat, nearly level, and of uniform width, rounded at the extremities; sides nearly perpendicular. Head whitish, labrum and sutures of clypeus yellowish, eyes black. Head retracted under joint 2. Along subdorsal ridge a row of elongate processes on joints 3 to 13, covered with short black spines from conical bases. The horns on 3, 4, 5, 11, 12, and 13 are about three times as long as the others. A similar superstigmatal row; on joints 3 and 4 lateral, none on 5, on 6 to 12 superstigmatal, that on 4 about as long as the subdorsal one, the others of uniform length,

longer and rather more slender than the short subdorsals—all spined. A row of dorsal and lateral depressions, each containing two irregular whitish dots, only appearing distinctly when the body is retracted. Skin covered with very minute, transparent granulations. Spiracles very small, circular, conical, projecting. Body sordid purplish, shaded with blackish, or green; a narrow yellow dorsal line. Subdorsal processes bright ferruginous or yellow, which color extends broadly along subdorsal ridge, interrupted between segments 6-7, 9-10, and 11-12 by a rectangular dark brown spot, the one between 11 and 12 smaller than the others. Lateral processes same color as the subdorsals but paler. Venter colorless, the thoracic feet small. Coloration of larva very variable.

**Euclea pænulata** Clemens.

I have no notes of my own on this species, and copy those of Prof. G. H. French.<sup>1</sup> "In general outline somewhat elliptical, the sides and back tapering from the middle to both extremities. Length .56 inch (14 mm.), width and height in the middle .25 inch (6 mm.). . . . The body . . . destitute of true feet<sup>2</sup> . . . a soft pliable membrane covering the ventral surface. General color of dorsal space dull purplish-brown, having, under the glass, a slight orange tinge. A fine dorsal line and a broader one each side, which alternately expands and contracts, of dull purplish-orange. On each joint, except 12, is a pair of impressed spots, which appear whitish when seen in certain lights. In the region of the subdorsum is an orange ridge containing tubercles which are covered with spines . . . of the same color as the ridge, except that between the last two there is a shorter black tubercle without spines. The second and third from each end of the body" [*i. e.*, on joints 4, 5, 11, and 12] "are larger than the others. A similar tubercled ridge . . . in the region of the stigmata. . . . Subdorsal space dull, purplish-orange, bordered above and below with purplish-brown, each joint containing two whitish impressed spots. . . . Below the lower line of tubercles, dull orange. . . ."

**Euclea plugma** Sepp.

According to Sepp's figure this larva has the structure of the two species just described. The subdorsal horns on joints 3 to 5 and

<sup>1</sup> Papilio, vol. I, p. 144.

<sup>2</sup> Prof. French repeats Dr. Packard's error in failing to observe the thoracic feet.

11 to 13 are longer than the others, which are about equal. The color is green with a bright vermillion dorsal line, and a white band below the subdorsal ridge, both bordered by a dark shade. The lateral region is of a paler green.

**Euclea dicolon** Sepp.

This larva is interesting for it differs from the typical structure of *Euclea* (to judge by Sepp's figure) in having the subdorsal horns on joints 6 and 10 shorter than those on 7 to 9, so that they are not shown in the figure. Perhaps, even, they are absent; but anyway we have an approach to the structure of the next genus, *Sibine*. The subdorsals on 3 to 5 and 11 to 13 are as long as the stigmatala. The body is gaily ornamented with streaks and spots of bright red on a green ground, the location of which I cannot positively determine from the figure.

**Sibine vidua** Sepp.

Sepp figures a larva which seems to be somewhat more generalized than our North American species. The subdorsal horns are absent on joints 6 to 10, but there is another pair of long ones behind those on 11; the lateral horns are long. Body green with a large square dark green patch on the back, broadly bordered with yellow; the horns are all dull purplish.

**Sibine stimulea** Clemens.

Head beneath joint 2, but 2 not beneath 3; joints 3 and 4 somewhat folded. Dorsum rises nearly perpendicularly in front, rounds over at joint 5, slopes gently and slightly to joint 11, and is then nearly perpendicular to the anus. No subdorsal ridge, the body evenly rounded, but the sides almost perpendicular. On joints 3, 4, 5, and 11 a pair of subdorsal fleshy processes, furnished with round, smooth tubercles, each of which bears a long, stiff spine, salmon colored, black at the end, "stinging." The processes on 3 and 4 are short, those on 5 and 11 very long (5 mm.). A similar row on joints 3-13, just above the spiracles, and absent on 5, all short, with an extra pair at the anus.<sup>1</sup> On 12 above the process, and on 13 posterior to it is an elevated brown structure like a large wart, or like many thick spines very close together, each tipped with a fine black point. Body smooth, with two dorsal and two

<sup>1</sup> In the absence of specimens of the larva, I cannot tell to what this note, made four years ago, refers.

lateral rows of little, shallow, pale colored pits. Color dark purplish vinous; a pale yellow, elliptical spot dorsally on joints 5 and 11 edged with blackish; a much larger similarly colored one on 12 on each side behind the large process; a large bright green patch covers the back and sides of 6 to 10 like a blanket, extending a little on 11 and 12 laterally, and leaving an elliptical patch of the ground dorsally on 7 to 9 like a hole in the blanket. The blanket patch is narrowly edged with black and broadly with white. Spiracles round, elevated centrally, finely radiate, yellowish. Venter whitish, nearly colorless. Thoracic feet small, tipped with brown. Head nearly colorless, black at the sides, mouth brown.

**Sibine trimacula** Sepp.

In this curious larva the long horns have disappeared, and we find on the corresponding segments rounded, spinous tubercles. The lateral series does not appear in Sepp's figure, and must be greatly reduced, perhaps to merely a fringe of spines. The light green blanket covers the whole of the dorsum and extends forward laterally to joint 4, being without a "hole" centrally, and bordered with yellow. The rest of the body is bright green, the small tubercles only retaining the purplish color. The larva is much less conspicuous than the others of its genus, in correspondence with the marked reduction of its defensive armor. I am unable to understand why Mr. W. F. Kirby should have placed the names of this species and *S. vidua* as synonyms of the same insect (*S. nesea*), as he has done in his catalogue.

**Parasa chloris** Herrich-Schäffer.

This larva is in a state of transition toward the second group. The tubercles are much reduced, and the color, though rather bright, is quite uniform, so that it is difficult to decide whether it is intended for warning or not.

Outline from above somewhat ovate, the last segment produced into a little pointed tail; dorsal region flat, highest at joint 5, diminishing to the extremities. Subdorsal ridge angulated, not elevated, bearing on each segment after 2 a large round wart covered with spines, those on 3, 4, 5, 11, and 12 large, the rest much smaller. A similar row above the spiracles, all small. The head is retracted within joint 2, and this in turn under joint 3. There is a double row of blackish impressed spots in the dorsal region, and elliptical depressions on the sides; but the skin is nearly

uniform, soft, and smooth. Color greenish-brown, lighter, more reddish posteriorly, shaded on the dorsum with dark orange; a number of indistinct, brighter, waved lines. Venter colorless, bordered by a salmon colored band.

## SECOND GROUP.

### **Phobetron pithecium** Abbot and Smith.

In this larva, the tubercles still remain, but the whole organism is modified to resemble a dead leaf. It is the most remarkable lepidopterous larva known to me. Its hairs retain some stinging power.<sup>1</sup> The tubercles are most peculiarly modified; they are extended laterally in the form of long fleshy arms, the tips of which are flexible and execute a certain amount of independent motion; they are strongly constricted at the base, and *are shed by the larva* at the time of forming its cocoon, though not at the molts. Moreover their normal position is altered. Instead of arising from the center of the segment, they are pushed forward to lie apparently between their own segment, and the one anterior. On account of their feeble attachment, they may be lost during the life of the larva through accident, and are not regenerated, as would be the case with hair structures which are formed afresh at each molt. .

Head whitish, eyes black, jaws black inwardly. Head below joint 2; but 2 not below 3. Dorsum flat, rounding posteriorly, the sides perpendicular; subdorsal ridge rounded, but bearing a row of ten processes on joints 4 to 13 respectively, arising apparently from between the segments subdorsally, the first between joints 3 and 4. All are curved backward, except the 6th to 9th, which curve forward, though they probably vary in this respect, owing to their power of motion. The 2d and 8th (joints 5 and 11) are longer than the 1st, 4th, 6th, and 9th (joints 4, 7, 9, and 12), and the 10th (joint 13) is very short. The 3d, 5th, and 7th (joints 6, 8, and 10) are very long.<sup>2</sup> All are furnished with thick short hair, parted in the middle and projecting laterally, and have a tuft of black spines and single long hair at the end. Their bases are swollen below and hairy. From the base of each process above, grows a spreading flattened tuft of fine hair which nearly cover the dorsum. A super-stigmatal row of spined tubercles, three in number on joint 3 (one

<sup>1</sup> See Lintner, 5th Report N. Y. State Entomologist, p. 183.

<sup>2</sup> In the specimen which served me for these notes the 3d pair had been lost.

representing the subdorsal process), two on joint 4, one a little above the other, none on joint 5, one each on joints 6 to 12. Spiracles small, round. Color of body and processes varying in different individuals from tan color to red or dark brown, like different kinds of withered leaves. Below spiracles, nearly white; venter clear pale yellow, semitransparent. Thoracic feet small, colorless.

Are these fleshy arms intended to come off in the grasp of an enemy, like the tail of a lizard, whereby the larva may escape injury, even though it be detected in its simulation of a dead leaf?

In respect to the number of tubercles and their armature, *P. pithecium* is the most generalized larva of the Eucleidæ, the nearest to *Megalopyge*.

**Phobetron tetradactylum** Walsh.

If the observations of Walsh are not founded upon error (of which I am by no means convinced) we have another species of *Phobetron* in this country which has escaped the notice of entomologists. Walsh says: "These larvæ were much larger than that of *hyalinus*" (which means nothing, as *hyalinus* is the ♂ of *pithecium*, and consequently small). "They agreed with it in having apparently nine pairs of appendages, the last pair very short; but they had only the 3d and 6th pairs projecting beyond the others, and both these pairs were curved backwards, with the extreme tips of each slightly hooked forward." I have shown that the direction of curvature of the arms cannot be relied upon, and it remains to be determined what is the range of variation in the proportionate lengths of the several pairs of arms before we can pronounce on Walsh's species.

**Sisyrosea inornata** Grote and Robinson.

Here also the tubercles remain; but the hairs are soft and without stinging power. The larva is colored for concealment.

Head pale green, eyes black, jaws brown; head under joint 2, 2 under 3. Body much flattened, elliptical, dorsal region flat, rising but little, narrowest centrally and widening to the extremities; sides sloping. Around the lateral region the body projects and bears a row of flattened, elongated, triangular, pointed projections, fringed on their sides by spines each tipped with a hair. The first of these projections is on joint 3 at the beginning of the subdorsal ridge, which, with the one on 3 laterally and 4, is red with black spines. (There is one on 3 subdorsally, another small one on 3 laterally, one on 4, none on 5, one on 6, but no gap as joint 5 is contracted at

base, its spiracle a little lower than the others). The other tubercles are pale green with white spines, the last one being on joint 13, longer than the others, and placed at the end of the subdorsal ridge. Along this ridge is a row of similar, but much smaller processes, projecting laterally and situated on joint 3 posteriorly, 4 posteriorly, none on 5, one on joints 6 to 12 inclusive centrally, color green or yellowish, the spines pale. The process on joint 13 really forms part of both the subdorsal and stigmatal rows.<sup>1</sup> The body segments, especially laterally, are a little elevated on their anterior edge, and contain a double dorsal and two lateral rows of small, whitish, impressed spots. General color light green; on the lateral area this color obtains only on the elevated portions, as seen by a lens. A distinct yellow line along the subdorsal ridge connected by a yellow spot on 9 anteriorly, which contains a red dot. In another larva two red dots on joints 9 and 11. Laterally, the elevated portions of the segment surround the spiracle and send off a ridge to the posterior edge centrally. In the two spaces thus formed are two elevations, depressed centrally, the upper slightly kidney shaped, the lower circular. A double dorsal row of impressed spots. Thoracic feet blackish, venter colorless.

***Tortricidia pallida*** Herrich-Schäffer.

This larva is entirely smooth, but has retained a bright red dorsal patch, which now does duty to give to the larva a deceptive resemblance to a red patch on a leaf.

Head retracted beneath joint 2, 2 beneath 3; greenish testaceous, mouth brown, ocelli black. Body elliptical, the sides sloping from a slight subdorsal ridge, contracted between joints 12 and 13, giving the last segment a square appearance. Color bright green, the dorsum largely covered by a patch of salmon color or purple-brown, bordered by a crimson line and a yellow shade. It begins somewhat broadly above the head on joint 3, narrows at once to a dorsal band on joints 4 and 5, widens twice, the second time passing down to the subventral edge of the body at joint 8, then narrows twice and tapers to a point at the anal extremity. The body is covered, very minutely, with transparent granulations. The usual elliptical depressions are hardly distinct, smooth, whitish in the dorsal patch, and containing a dorsal and lateral row of blackish spots. Length 9 mm.

<sup>1</sup> There are thus three less tubercles in *Sisyrosea* than in *Phobetron*: viz., the third one on joints 3 and 4, and the subdorsal one on joints 5 of *Phobetron*, are wanting in *Sisyrosea*.

**Tortricidia minuta** Reakirt.

Unknown since 1864, so far as I am aware. It is to be hoped that some one may find it again. Reakirt says: "Length  $2-2\frac{1}{2}$  lines" (about 4-5 mm.); "basal outline elliptical; a flattened ridge widest at the center [= dorsal area] extends from head to tail, curving over vertical elevations at the sides, which gradually diminish before and behind, and terminate at both ends in a rounded margin. Around the base, a row of small, densely spined papillæ" [lateral tubercles retained?], "two of which on the head" [meaning joint 3?] "are the most prominent and colored yellow. The body is smooth, but the ridge [dorsum] is thrown into thick fleshy folds; it is thickest in the middle, whence it diminishes anteriorly and posteriorly. [Color] green; two bright red lines of equal length, cross each other at right angles on the central portion of the upper ridge . . . ."

**Tortricidia fasciola** Herrich-Schäffer

Outline elliptical, contracted between joints 12 and 13, joint 13 forming a square projection. Dorsal region flat, arched over; subdorsal ridge slight, serving to separate the dorsum from the sides which laterally form a decided ridge, below which the body again contracts to venter. Head retracted under joint 2, 2 under 3. Body thickly covered with transparent elevations, which appear somewhat flattened on the dorsal region. Color pale yellowish-green; a yellow line on each subdorsal ridge and on the stigmatal ridge, all meeting on joint 13, and the two subdorsal lines also meet anteriorly by a connecting line on joint 3. A dorsal and a large and a small lateral row of dark green spots, surrounded by yellow, besides a row of yellow dots on each side the line on the subdorsal ridge, along which the green predominates in round, somewhat elevated spots. Below the stigmatal ridge is a row of green spots, surrounded by white and resting just above the white band bordering the colorless venter. There are certain minute, pale, setæ to be distinguished on the ridges by the aid of a lens.

**Apoda y-inversa** Packard.<sup>1</sup>

Head green, mouth parts dark brown, eyes black; retracted below joint 2, which is in turn retracted below 3. Body elliptical, tail

<sup>1</sup> These larvæ I have found several times, but never bred. The name is an assumption. They may be *A. biguttata*, or possibly *Heterogenea flexuosa*, though I do not think it likely.



quadrate, sides sloping, the subdorsal angle about  $75^{\circ}$ ; dorsum narrowing before and behind, evenly arching. Watery granular, whitish-green (not yellow), the pigment lying below the surface. A subdorsal white band along the ridge, edged above with blackish-green. Dorsal and lateral blackish impressed spots, seen distinctly only centrally. The subdorsal lines approach each other closely at the extremities. Spiracles white, brown centrally; a subventral white line. Thoracic feet small, tipped with brown. Venter smooth, clear, colorless, translucent, without legs. Length 15 mm.; width 8 mm.

**Packardia geminata** Packard.

Body elongate elliptical, sides nearly perpendicular, slightly ridged above the spiracles; dorsal region flat, highest at joint 7 and sloping each way; subdorsal ridge moderately prominent, straight; joint 13 prolonged into a pointed tail very faintly marked with reddish toward the end. Along each subdorsal ridge is a series of little conical tubercles (seen with a lens), two per segment, close together and each bearing a very short seta; a similar row along the superstigmatal ridge, but single and smaller, and the setæ even shorter and finer than those on the subdorsal ridge. A series of dorsal and lateral depressions, not distinctly different from the rest of the body in structure or color, though the lateral ones are slightly darker. The body is thickly covered with little transparent granulations. Color pale, decidedly whitish green (not yellowish), a white line along the subdorsal ridge bordered above with dark green, the lines obsoletely connected on joint 3, but not passing on to the tail. A row of obscure white dashes along the superstigmatal ridge, looking as if beneath the surface of the skin. Spiracles small, round, projecting, white. A faint whitish line separates the clear colorless venter from the sides. Head pale green, the mouth parts largely dark brown. It is retracted below, and folded within joint 2, which has the spiracle somewhat flattened. Length of larva 14 mm., width 6.5 mm.

**Packardia elegans** Packard.

Head retracted under joint 2; joint 2 partly under joint 3; dorsal region narrow; body highest at joint 7, rounding to the extremities. Subdorsal ridges distinct, not raised, segmentally undulate, approaching each other posteriorly and marked with a yellow line which begins on joint 3, not joining over the dorsum. Sides nearly

perpendicular, a little sloping and bulging superstigmatally, but not forming a decided lateral ridge; joint 13 produced into a rather long, narrow, pointed tail, marked with reddish-purple above. Body closely covered with small transparent granulations; color light yellowish-green, dorsal region dark green, with a small dorsal dot on each joint (joints 6–11) largely surrounded with pale yellowish-green, reaching to the subdorsal lines except on joint 11. Sides nearly uniform yellowish-green; above the lateral bulge is a segmental row of depressed darker spots, beginning on joint 4 and becoming indistinct after joint 9; on the lateral bulge a row of yellowish spots on joint 6–9. Spiracles white, small, round, conically elevated. A white line borders the venter, which is colorless. Thoracic feet small, abdominal ones wanting, as usual in the family. Head green, jaws brown, ocelli black. Length of larva 11 mm., width 5.5 mm., height 3.5 mm.

The subdorsal and lateral ridges have traces of tubercles, not elevated, but a little smoother than the rest of the body, bearing very minute short setæ, just perceptible with a lens in certain lights.

***Eulimacodes scapha* Harris.**

Head retracted under the fleshy folds of joint 2, joint 2 under 3. Body highest at joint 7, the dorsum rounding over rapidly to head and tail. Sides perpendicular, sunken in the middle. Subdorsal ridge sharp, elevated; dorsum flat; joint 13 produced into a pointed tail. The ridge on each side, at joints 7 and 8, is elevated into a rounded, smooth process, or there may be only one process or none. Body segments not well distinguished; on the sides joints 3 and 13 have one, 4 to 12 two (one above the other), smooth, irregularly elliptical plates; on dorsum joints 3–13 have each a plate, hexagonal, transversely elongate, as wide as the dorsum, the angles between the successive plates filled in with little triangular pieces. Between the dorsal and lateral series of plates the skin is closely scaled. Body smooth, the scaled part shining. Color green, a large round white spot on the subdorsal ridge on joint 10, or there may be two or even three of these spots. Usually there is only one prominence on the subdorsal ridge, viz., on joint 7. The body is often all green with a narrow yellow dorsal line, or the back or sides in patches or even very extensively marked with brownish cream color on the plates, and dark brown mottlings on the scaled parts. These markings are not quite alike in any two individuals. Spiracles pale whitish. Thoracic feet minute, abdominal feet absent, the venter

sticky and transparent. A broad white band separates the transparent venter from the green sides. Head of a whitish color, jaws brown. Joint 2 transparently granulated and marked with brown.

#### THE SPECIALIZED FRENATÆ OR MACROLEPIDOPTERA.

*First Division* (corresponding in a general way to the Specialized Frenulum Conservers of Comstock).

The most primitive form of arrangement of the tubercles is seen in that great group including the Noctuidæ, Notodontidæ, and their allies. The tubercles are simple, single haired. Tubercles iv and v are well separated, iv tending to become situated just behind the spiracle. The setæ of vii are never consolidated into a distinct wart, but the three hairs are scattered on the outside of the leg, or on the chitinous leg plate, which is frequently developed. The two subventral tubercles are thus v and vi, instead of vi and vii, as in the Microlepidoptera, and appear to be situated the upper *anterior*, the lower *posterior*.

Specialization begins in a multiplication of the number of hairs on each tubercle; but right here there arises a new line of modification. It consists in the presence of hairs arising from very minute tubercles all over the body. We shall see this modification again in several different lines of descent; but it probably reaches its maximum among the Notodontidæ in *Apatelodes torrefacta*. Here it has replaced the process of multiplication of hairs on the tubercles, which seem to be still single haired. The result of this process in our *Apatelodes angelica* and in the South American genus *Rosema* is the production of a structure closely like that of the Lasiocampidæ.

Several different modifications of the legs among the most generalized Macrolepidoptera may now be noticed. The first consists in the abortion of the two anterior pair of abdominal legs as seen in the lower Noctuidæ, followed by the complete removal of the three anterior pair as in the Geometridæ, resulting, of course, in a looping method of progression. It may be noticed, in passing, that this modification is much more strongly presented in certain Noctuids in the first larval stage (embryonic larva) than later in life, which might lead to the conclusion that the Noctuidæ were descended from geometrid-like ancestors, if we regarded the first larval stage as always representing a generalized condition. This conclusion would be, evidently, the reverse of the truth, as the specialization in the

first stage is for the purpose of giving to the little larvæ a very rapid method of progression, enabling them to quickly disperse and find the food of which they have immediate need.

The second method of modification of the feet is illustrated by the Drepanidæ. It consists in the abortion of the last pair of feet with an enormous hypertrophy of the anal plate as shown by Dr. Packard,<sup>1</sup> resulting in the production of a new means of defense.

The third modification consists of the lengthening of the last pair of feet and their conversion into repellant organs by a peculiar development of the extensile part of the end of the foot, whereby it becomes a long eversible flagellum. All stages in this process are illustrated among the Notodontidæ. Here again we may note that in the genus *Macrurocampa*, the modification of the feet reaches its greatest development in the first larval stage, where they are longer than the body of the larva, again a special adaption to the fearful struggle to which these newly born larvæ are subjected.

We now pass to the second group in which the tubercles are many haired. This probably includes all the remaining families of the Macrolepidoptera. In some, however, modification has progressed so far that the tubercles are entirely lost, and, in the absence of generalized genera, it is impossible to be certain from which type they were derived. The Lithosiidæ show the beginning of the modification in that several of the tubercles bear two hairs. Then follows a series of families in which the tubercles are converted into warts. The hairs are at first simple or finely cleft; but in the higher families, especially in the Phægoterinae, Lymantriidæ, and Euchromiidæ, they are developed into various brushes, tufts, and plumes. This is the highest degree of specialization in this line, and is accompanied by an irregular reduction of the warts. In the genus *Nola* of the Lithosiidæ we have an extreme of unequal reduction, similar to that in the Lycænidæ, and accompanied with the loss of the anterior pair of abdominal feet.

#### Family Noctuidæ.

##### *Achatodes zeæ* Harris.

I have examined a larva prepared by Mr. Wm. Beutenmüller. The tubercles are surrounded by large black areas: i anteriorly, ii posteriorly, iii lateral, a minute spot before the spiracle, iv behind and at base of spiracle, v anteriorly, and vi posteriorly subventral.

<sup>1</sup> Proc. Boston Soc. Nat. Hist., XXIV, 484.

A large black leg-shield. Tubercles vii and viii appear ventrally on the legless segments.

**Acronycta** sp.

An undetermined larva occurred to me at Woods Holl, Mass. The tubercles are represented by large hairy warts arranged as above, except that iv, posterior to the spiracle, is much smaller than the others.

Family **Agaristidæ**.

**Alypia octomaculata** Fabricius.

Body enlarged at joint 12 (8th abdominal segment) with low conical tubercles, smooth, not shining nor granular, each bearing a single pale hair, and arranged perfectly normally; iv rather small, behind and a little below the spiracle. No other hairs.

Family **Lithosiidæ**.

**Sarrothripa revayana** Scopoli.

No warts nor tubercles perceptible, but the single hairs are arranged in the same manner as the warts of the *Arctiidæ*; row iv is just below the stigmatal line, the hairs each a little back of a spiracle; v anteriorly . . . . in the subventral space (*Psyche*, vol. VI, p. 260).

**Tyria jacobææ** Linnæus.

A prepared specimen at the American Museum of Natural History. Tubercle i anterior, ii posterior, iii lateral, iv stigmatal (posterior) small, v subventral, vi subventral posteriorly with *two hairs*, vii with *four hairs*, viii with one hair.

**Nola minuscula** Zeller.

First wart (ii) very large, oblong as if of two coalesced, second lateral (iii), third subventral (v), also large, and fourth (vi) very small, also subventral. Warts bearing spreading, long, thin hairs (see *Psyche*, vol. VI, p. 248).

Family **Notodontidæ**.

**Heterocampa manteo** Doubleday.

Single setæ, arising normally. Tubercle iv is behind and below the spiracle.

**Pheosia dimidiata** Herrich-Schäffer.

I have shown how the setæ of i are borne on the base of the fleshy horn on 8th abdominal segment and are not united (see *Psyche*, vol. VI, p. 194).

All the species of *Datana* and *Ichthyura* illustrate the secondary hairs arising from the skin.

Family **Geometridæ**.

**Calocalpe undulata** Linnæus.

Corresponding to the absence of legs on so many segments, and the consequent exposure of the ventral surface, we find the three tubercles of vii well separated, and each as well developed as any other on the body. The arrangement is: i at anterior third of segment; ii at posterior third and a little lower down; iii lateral, anterior; iv some distance behind the spiracle opposite its lower edge; v before the middle on the substigmatal ridge; vi anterior, subventral, nearly in line with vii a; vii b posterior, vii c anterior, and viii again posterior, each a little nearer the midventral line than the preceding one.

Family **Drepanidæ**.

**Oreta rosea** Walker.

This little larva has lost all trace of tubercles. It is granular, the segments annulate, with a large unpaired process dorsally on the metathoracic segment.

**Platypteryx arcuata** Walker.

I have not had this larva for special examination. It occurred to me in Plattsburgh, N. Y., on the black birch and alder; but I have apparently fallen into some error in my notes in regard to the tubercles. Still, I give them, as they show tubercle iv to be in the required position.<sup>1</sup>

Head higher than joint 2, bilobed, subquadrate, sutures distinct; sordid whitish, the small clypeus red-brown; two dark red-brown, arcuate, concentric bands cross the head transversely, the lower from

<sup>1</sup> In correcting the proof I am able to explain the apparent anomaly. I have found a dead larva in an old cocoon. There are several secondary hairs developed, one of which is very distinct, situated near tubercle iii, the others subventral. My notes are correct, except that I did not mention tubercle vi, which is present posteriorly, subventrally. The arrangement is the normal one of the *Macrolepidoptera*.

the ocelli over the clypeus, the upper across vertices of lobes; ocelli black; some long pale setæ from minute tubercles; width about 1.8 mm. Body thick, slightly flattened, of nearly even width, but the last segments tapering. Anal feet absent, the suranal plate produced into a conical, rounded process as long as the plate. Tubercles mostly small: 1 anterior, 2 posterior, 3 and 4 lateral in line [?], 5 stigmal posteriorly [= iv], and 6 substigmal [= v]. On joints 3 and 4 there are 1 to 3 near together, 4-5 in line, 6-7 in line subventrally, and more on base of foot, each with a single, long dark seta. On joints 3-4, tubercle 2 is red, elongate, 3 is black, giving the appearance of horns when there are none. Color light green, whitish ventrally. A purplish subdorsal band, the dorsal space filled in with purplish from joints 5 to 13. There is some variation in markings.

Family **Arctiidæ**.

The tubercles are converted into large warts bearing many hairs. I have frequently referred to the arrangement.<sup>1</sup>

In the subfamily Phægoterinae tubercle iv becomes small.

Family **Pericopidæ**.

**Gnophæla vermiculata** Grote and Robinson.

From the descriptions by Mr. D. Bruce<sup>2</sup> and Mr. T. D. A. Cockerell,<sup>3</sup> I infer that the tubercles do not differ from those of the Arctiidæ. These descriptions are among the very few that have been of any service to me in the present investigation, and I am duly grateful for them.

Family **Euchromiidæ**.

The tubercles are like those of the Arctiidæ, as may be seen by referring to my descriptions in *Insect Life*, vol. II, pp. 360-362. Many of the species have tufts of hair as in the next family.

Family **Lymantriidæ**.

I have described so many of these species that I will not take up space here. I refer to the pages of *Psyche*. I would, however,

<sup>1</sup> See *Entom. Americana*, vol. VI, p. 74 (1890). The numbers correspond with those now adopted, except that (7) includes vii and viii.

<sup>2</sup> *Entom. Americana*, vol. IV, p. 24.

<sup>3</sup> *Entom. Americana*, vol. V, p. 57.

again call attention to the fact that tubercle iv is large and well developed in *Porthetria dispar*, the "gypsy moth;" but very small in our native species of *Notolophus* (= *Orgyia*).<sup>1</sup>

#### Family **Lasiocampidæ**.

This family, which closes our first division (unless the alternative view which I will suggest for the position of the Sphingidæ be adopted) has pursued a different line of development. The warts have become reduced even to obliteration, and are largely replaced by hairs arising from the skin. But these have made no great advance in many species, owing to the fact that the larvæ may be protected by their resemblance to the bark of trees on which they rest.

I am struck by the fact that Mr. W. F. Kirby has placed the Notodontian genus *Apatelodes* among the Lasiocampidæ.<sup>2</sup> Now the larva of *A. angelica* bears a most striking resemblance to many Lasiocampid larvæ, though probably a fallacious one. But, as this larva is, without doubt, unknown to Mr. Kirby, I am at a loss to understand his reference. Is there a closer relationship here than appears at first sight?

#### ***Clisiocampa pluvialis*** Dyar.

This larva seems to exhibit, imperfectly it is true, the location of all the tubercles. I have received some nicely prepared examples from Prof. O. B. Johnson. Tubercle iv is shown just behind the spiracle in Fig. 6; but there will be noticed two additional ones on the anterior annulet. It is difficult to make out anything positively owing to the extreme reduction of the tubercles and the considerable development of the body hairs. This is the most generalized Lasiocampid which I have seen.

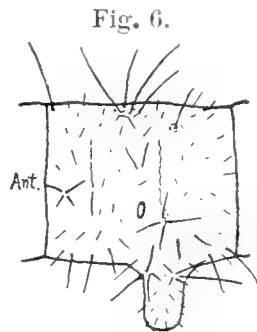


FIG. 6.—A segment of *Clisiocampa pluvialis*.

#### ***Tolype velleda*** Stoll.

There are two hairy warts, corresponding to ii and v, with another lateral row on the thoracic segments. There is a dorsal prominence on the 8th abdominal segment, which bears the two tubercles i of each side.

<sup>1</sup> See my description in Proc. Boston Soc. Nat. History, vol. XXVI, p. 155.

<sup>2</sup> Cat. Lep. Het., vol. I, p. 851.



**Artace punctistriga** Walker.

The arrangement is the same. The larvæ which Dr. Packard has kindly loaned to me are very small and the structure is difficult to make out.

**Heteropacha rileyana** Harvey.

A slight hump on the 8th abdominal segment like a small fleshy horn. No tubercles, except on the prothoracic segment where there are traces of three on each side.

**Phyllodesma americana** Harris.

There are no tubercles. There is a dorsal prominence on 8th segment, and the subventral region is hairy.

*The Second Division* (corresponding partially to the Frenulum  
Losers of Comstock).

This division shows the most varied forms of modification, which would require too much space to describe in detail. We see exhibited nearly all the higher modifications of the tubercles previously described, and in addition certain new ones. These have been already referred to. There is one set of characters which we do not find largely developed in any family of the Frenulum losers. This is the great development of hairs illustrated by the Arctiidae and allies.

In the present division the feet are not modified. I know of no instance in which they have departed from the primitive type or been modified for any other purpose than their natural one. There are, however, several instances of highly modified eversible glands. These structures are met with in various families throughout the Frenatae; but, as they are clearly not the homologues of tubercles, it is not within the scope of this paper to enter into a discussion of them.

Family **Lycænidæ**.

Judging from W. H. Edwards's figures,<sup>1</sup> the structure of the tubercles is essentially that of the highest Microlepidoptera and of the Lithosiidae (genus *Nola*). I have, at present, no evidence showing from which type it has been derived. Mr. Edwards figures *Lemonias nais* as a very hairy larva with apparently three rows of

<sup>1</sup> Butterflies of N. A., vol. II.

warts. In *Lycæna pseudargiolus* all the warts have disappeared and the larva is highly modified. It is a pity that Mr. Edwards's plates do not show the tubercles in more detail.

Family **Papilionidæ.**

These are among the most generalized of the Butterflies. We can see in the younger stages of many species round spinous warts representing nearly all of the tubercles, though usually i and iv have disappeared.<sup>1</sup> In the adult larva the tubercles have disappeared; but they may be represented by spots or long fleshy horns.

Family **Nymphalidæ.**

There is a remarkable range of variation in this family. *Danaïs archippus* shows a structure allied to that of *Papilio philenor* in its long fleshy horns. In *Apatura* and in the *Satyrinæ* the tubercles are absent after the first molt; and in *Liminitis* and *Heterochroa* the body is covered with a whole mass of secondary tubercles and spines. In the genera represented by *Heliconius*, *Argynnis*, and *Vanessa* we have an entirely different arrangement. Tubercle i is consolidated into a single unpaired process on the dorsal line. In the mature larva there are usually only four processes: (1) dorsal, unpaired, (2) subdorsal, (3) lateral, and (4) substigmatal; but in the first stage of *Melitæa phæton*, Gruber<sup>2</sup> shows four processes besides the dorsal one, *i. e.*, only tubercle iv lacking.<sup>3</sup>

Family **Pieridæ.**

In this family the tubercles are gone, the body covered with fine short hairs. I have not examined the tubercles which are present in the first stage. Edwards's figures only indicate them.

Family **Hesperidæ.**

As in the *Pieridæ* the tubercles are gone. The form of the larvæ is characteristic, with large head and small prothoracic segment.

<sup>1</sup> See article by A. Gruber in *Jena. Zeit. für Naturwissenschaft*, vol. XVIII, pp. 465-489 (1884).

<sup>2</sup> *Ibid.*

<sup>3</sup> In *Heliconius* and in *Argynnis diana* the whole row of unpaired dorsal processes is lacking. A whole article might profitably be devoted to the variation of the tubercles of *Nymphalidæ*.

Superfamily **SATURNINA.**

We have an unpaired dorsal tubercle on both the 8th and 9th abdominal segments, the first corresponding to i, the second to ii, as tubercle i is not present on the 9th segment. The *Citheroniidæ* is the most generalized family, tubercles i (on 8th abdominal segment), ii, iii, v, and vii being present in *Citheronia splendens*. In the other genera the number of tubercles on the 8th segment is reduced, usually by the removal of ii; but in *Anisota*, i has disappeared. It should be understood that I exclude the *Lacosomidæ* from the Saturnina; otherwise I accept Prof. Comstock's arrangement.

Family **Sphingidæ.**

The position which I have assigned to this family is only tentative. The larvæ are so highly specialized that it is very difficult to get any clue to their relationship. The only trace of the tubercles that is left, is the "caudal horn," an unpaired dorsal process on the 8th abdominal segment. The view which I have adopted here, that this horn represents the consolidated tubercle i of the Saturnina has no more to support it than the other view that the horn represents the base of the unconsolidated pair of tubercles i, the tubercles themselves having disappeared. The tendency to the formation of this structure has been referred to in the case of the *Notodontidæ* and *Lasiocampidæ*. This view would place the *Sphingidæ* at the end of the Frenulum Conservers, next to the *Lasiocampidæ* in my table; and I wish to state that, as far as I am able to judge from the mature larvæ, either position is equally supported.<sup>1</sup>

<sup>1</sup> The larva in stage I, which I have excluded from consideration, is figured by Weismann in the case of the European *Deilephila euphorbiæ* (Studies in the Theory of Descent, Pl. V, fig. 38), and setæ are present. Unfortunately, the figure appears to have been made without sufficient care as regards the arrangement of the tubercles. There is no description except "on each segment there are a number (mostly ten) of small warts, each of which emits a single bristle." The figure represents all the tubercles present except iv, though v and vi seem to be situated too high. On abdominal segment 8, the two setæ of tubercle i are borne on the apex of the caudal horn. If the structure of this embryonic larva is to be trusted, the conclusion seems irresistible that the alternative position which I suggest for the *Sphingidæ* is the proper one, and not the one which I have adopted above, following the conclusions of Mr. A. R. Grote (Canad. Entom., vol. XXII, p. 15), and of Prof. E. B. Poulton (Trans. Ent. Soc. London, 1888, pp. 568-574).

# ANNALS

## OF THE

### NEW YORK ACADEMY OF SCIENCES.

---

The "ANNALS," published for over half a century by the Lyceum of Natural History, are continued under the above name by the New York Academy of Sciences, beginning in 1877. Six volumes of the new series have now been issued.

With the beginning of the fourth volume, the Academy decided to change somewhat the mode of publication. The ANNALS are henceforth issued without particular reference to times or periods. The parts will appear as material for them shall be offered; each single part, or number, as before, will contain at least 32 pages, with or without plates; twelve numbers, as before, whenever published, will constitute a volume. The size and general character of the parts and volumes will not be changed; nor is it intended at all to reduce the average yearly amount of matter.

The ANNALS include the more extended and elaborate papers laid before the Academy. The briefer papers and discussions that form part of the Academy's meetings appear in its other publication, the TRANSACTIONS, which it is designed to issue promptly and regularly, so as to give a record of the current work of each year,—the single numbers appearing monthly (or double, bi-monthly), and eight single numbers forming an annual volume.

By vote of the Academy, both these publications will be sent FREE to its Resident and Honorary members. To non-resident members the price of the TRANSACTIONS will be \$3.00 per year.

To all others, prices will be as follows:

|  |           |               |
|--|-----------|---------------|
| Annals, single numbers,                      | . . . . . | Fifty Cents.  |
| " double or multiple numbers, in proportion. |           |               |
| " per volume (12 numbers),                   | . . . . . | Six Dollars.  |
| Transactions, per year,                      | . . . . . | Five Dollars. |
| " single numbers,                            | . . . . . | Fifty Cents.  |

All communications should be addressed to

THOS. L. CASEY,  
*Army Building,*  
*New York.*

Or to

J. F. KEMP,  
*Columbia College, New York.*

The Academy has for sale a number of back volumes of the ANNALS of both series, each containing twelve or more numbers; the price per volume is Five Dollars in the old (Lyceum) series, and Six Dollars in the new (Academy) series.

## CONTENTS.

---

|   | PAGE |
|---|------|
| V.—Reversal of Cleavage in a Sinistral Gasteropod. By HENRY E.<br>CRAMPTON, JR. . . . . | 167  |
| VI.—Certain New Derivatives in the Aromatic Series. By HARWOOD<br>HUNTINGTON . . . . .  | 171  |
| VII.—A Classification of Lepidopterous Larvæ. By HARRISON G.<br>DYAR, S. B. . . . .     | 194  |

Vol. VIII.

February, 1895.

No. 5.

ANNALS  
OF THE  
NEW YORK ACADEMY OF SCIENCES,  
LATE  
LYCEUM OF NATURAL HISTORY.



New York:  
PUBLISHED BY THE ACADEMY.  
1895.

OFFICERS OF THE ACADEMY,  
1894-95.

---

President.

J. K. REES.

Vice-Presidents.

R. P. WHITFIELD,

HENRY F. OSBORN,

Corresponding Secretary.

T. L. CASEY.

Recording Secretary.

J. F. KEMP.

Treasurer.

CHAS. F. COX.

Committee of Publication.

J. A. ALLEN,

J. F. KEMP,

HAROLD JACOBY.

H. F. OSBORN,

THOS. L. CASEY (EDITOR OF ANNALS).

## VIII.—*A Monograph of Scytonotus.*

BY O. F. COOK AND A. C. COOK.

Read March 26, 1894.

As is the case with nearly all the extra-European genera of Diplopoda, and especially with the American, the more important characters of *Scytonotus* have been misunderstood or entirely overlooked. This is evidenced by the fact that all the European writers who have touched upon the subject have either made direct misstatements concerning the characters and affinities of the genus, or have referred to it species having scarcely any important features in common with the typical form.

The genus is furthermore interesting in that its secondary sexual characters show it to be the most specialized of the Polydesmidae—characters which seem to be entirely unmentioned in the literature of the subject.

Genus **SCYTONOTUS** C. L. Koch.

Systems der Myriapoden.

Segments 19, covered with setiferous granules; supplementary margin pectinate; repugnatorial pores on smooth, rounded elevations of segments 5, 7, 9, 10, 12, 13, 15, 16, 17; male genitalia bihamate.

Body small, 5-6 times as long as broad; cavity slightly depressed.

Antennæ moderately clavate, third joint as long as the two preceding joints taken together, joints in order of length: 3, 6, 5, 4, 2, 1, 7.

Mandibular stipe with exposed surface divided by sutures into six areas, five triangular, one trapezoidal.

Masticatory plate long triangular, with numerous (15-20) transverse ridges.



Dentate lamellæ with four rounded teeth.

Pectinate lamellæ six.

Mentum triangular-cordate, sub-equal in length and width, moderately emarginate posteriorly, acute-angled anteriorly.

Cardo large, nearly half as long as the mentum.

Lingual lobes with few cones; median lobe with styliform processes.

First segment sub-elliptical, narrower than either the head or the second segment.

Anterior segments laterally curved forward, the posterior with the corners produced caudad; dorsal surface of all the segments densely roughened with setiferous granulations more or less regularly arranged in 4-6 transverse rows.

Lateral carinæ narrow,  $\frac{1}{4}$  as wide as the body cavity, thick, granular-serrate, reduced or obsolete on segments 6-9 in females.

Anterior sub-segments punctate.

Supplementary margins finely pectinate.

Repugnatorial pores opening dorsally on smooth elevations near the posterior corners of segments 5, 7, 9, 10, 12, 13, 15, 16, 17.

Anal segment tuberculate, decurved, acuminate, truncate at apex, with four setæ.

Anal valves with two setigerous tubercles, not placed on the raised margin.

Pre-anal scale semi-elliptic, with segiterous tubercle on each side.

Legs of male much larger than those of female, some of them crassate and specially modified for copulation; second joint without spine; joints of normal legs in order of length: 6, 3, 2, 5, 4, 1; terminal joint inferiorly tuberculate-serrate in male, the sub-terminal inferiorly papillate.

First pair of legs free, small and slender, the coxa longer than any other joint except the last.

Second pair of legs free in female; of the same shape as the succeeding; coxa not specially modified.

Genitalia of female sub-spherical, external, protrusible.

Genitalia of male bi-hamate, the distal hamus articulated at base, beset with fine laciniae; basal joint expanded to receive the distal.

Segments of adult 19.

*Distribution.*—Northeastern North America.

From *Polydesmus* this genus differs in having the dorsal surface uniformly covered with small, setiferous granulations, arranged in 4 to 6 rows; in having 19 less segments and no pores on segments 18 and 19; the pores on rounded elevations.

From *Brachydesmus* it is distinct in the convex dorsum covered with sub-equal squamæ arranged in 4-6 transverse rows, instead of having three rows, with the anterior squamæ and those of the carinæ several times as large as the others.

From both genera the bi-hamate male genitalia, with the distal joint articulated at base, are a diagnostic character, for the eighth legs of the other genera are replaced by a single falcate structure. Polydesmus and Brachydesmus are much more closely related to each other than either is to Scytonotus.

Porat seems to think that this genus is closely related if not identical with Brachydesmus, because of the 19 segments, but this inference would seem unnecessary. It is evident, too, that he takes an expansive view of generic limitations, necessary to include his species *Scytonotus digitatus*, mentioned again below. Wood had already recorded in his Monograph that the present species has but 19 segments, with no pores on the last two. He also pointed out the fact that the distal joint of the male genitalia is articulated at base, but all European writers seem to have ignored these observations.

Notwithstanding the fact that several species from different parts of the world have been referred by their authors to Scytonotus, it seems probable that the genus as here described is monotypic, or at least confined to Northeastern North America. Reasons for this view may be stated briefly in detail as follows:

**Scytonotus laevicollis** C. L. Koch.

System der Myriapoden, p. 131.

Die Myriapoden, II., p. 41, fig. 163.

This species seems to have been founded on an entirely insignificant difference, as the author himself admits. A large suite of specimens from different localities shows that the roughness of the first segment is subject to much variation, being usually less in females (?)

**Scytonotus nodulosus** C. K. Koch.

System der Myriapoden, p. 131.

Die Myriapoden, II., p. 43, fig. 165

According to the original description this species has 31 legs in the male, a unique condition of things unless the genitalia are enumerated. The diagram gives 20 segments, and the dorsal sculpture (three rows of scale like elevations, the anterior and

lateral larger) is such as to leave no doubt that the species intended is one of a group of small North American forms with 20 segments, not yet separated from *Polydesmus*, but probably more nearly related to *Brachydesmus*. That this latter genus can be maintained *solely* upon the difference of one in the number of segments would seem improbable, for this difference may be reasonably ascribed to arrested development, and the small size of the species with 19 segments gives force to the idea that they are depauperate forms. Nevertheless, the number of segments in the adult has never been known to vary in a species, and this fact gives it great importance.

***Polydesmus* (*Scytonotus*) *arcticollis* Peters.**

Monatsber. d. Akad. f. Wissensch. zu Berlin (1864), p. 539.

This Venezuelan species is given as having 20 segments and a pattern of dorsal sculpture very different from *S. granulatus*. Peters himself afterward placed it in a new subgenus, *Trachelodesmus*.

***Polydesmus* (*Scytonotus*) *cæsius* Karsch.**

Troschel, Archiv. f. Naturgesch (1881), p. 42.

A New Zealand species, apparently having little affinity with the American form, since the author says: "Segmentis alatis subglabris, medio serie transversa arearum subquadratarum circumcissarum ornatis."

***Polydesmus* (*Scytonotus*) *woodianus* Humbert et Saussure.**

Rev. et Mag. de Zool. (1869), p. 152.

A Mexican species with the dorsal surface wrinkled, a few small flattened and scattered granules, broad, dentate carinae, no elevations for the repugnatorial pores, and 20 segments. In their larger work on the Myriapoda of Mexico the authors have ignored *Scytonotus*, even as a subgenus, and referred the species back to *Polydesmus*. That their species is congeneric with *P. complanatus* of Europe cannot be reasonably maintained, and it seems to have even less affinity with *Scytonotus*. Neither does it seem to

accord with any of the described genera, and future investigation may result in the erection of a new genus for its reception.

**Scytonotus cavernarus** Bollman.

Entomologica Americana, Vol. III, p. 45.

"Allied to *nodulosus* Koch. Pure white throughout. Slender, somewhat depressed, acuminate anteriorly. Antennæ exceeding the width of body, clavate. First dorsal plate elliptical, angles sharp; scales arranged in five transverse series, anterior row sharp, setigerous, all covered with fine granulations. Other dorsal plates with all the lateral sides sharply and deeply four or five toothed, scales arranged in four rows, the posterior row more or less setigerous, on posterior segments the anterior row is not very distinct. Repugnatorial pore scale large and swollen. Legs moderately long and slender.

"Length of body, 11 mm.; width, 1.5 mm.

"*Habitat*: Mayfield's Cave, Bloomington, Indiana.

"This species is described from one female found in motion on the floor of the above cave in October, 1886. As already stated, this species is more nearly related to *nodulosus*, but as *granulatus* is the only species so far found in the vicinity of Bloomington, I suppose it is descended from *granulatus*."

The above original and only description of this species makes its generic assignment a matter of doubt. *Nodulosus*, as has been shown, is not con-generic with *granulatus*. That Mr. Bollman's species is at once more nearly related to *nodulosus*, but descended from *granulatus* necessarily involves the further inference that *nodulosus* and related species are likewise descended from *granulatus*, for which supposition there seems not to be sufficient ground. There is also nothing to indicate that Mr. Bollman counted the segments, and his animal may be a species of *Brachydesmus*, the European species of which are largely cavernicolous.

**Scytonotus setiger** (Wood) Bollman.

Trans. Am. Philos. Soc. (1865) p. 214.

Proc. U. S. Nat. Mus. (1888) p. 340.

Mr. Bollman referred this species to *Scytonotus* probably because he recognized in it a congener of *S. nodulosus* Koch.

***Scytonotus digitatus* Porat.**

Nya Bidrag till Skand. Halföns Myriap. (1889) p. 24.

This species was described from a conservatory in Sweden and is, no doubt, exotic and probably tropical. Its characters are certainly very remarkably different from those of *Scytonotus*, and from any other described genus. We suggest that it be considered the type of a new genus, under the name **Poratia**. The digitately lobed carinæ are a character sufficiently bizarre, but equally important as a means of distinguishing it from *Scytonotus* is the fact that the 5th antennal joint is longest and thickest, followed in length by the 6th, 2d, 4th, 3d, and 7th, and that the 2d joint of the legs is nearly as long as the 6th.

***Scytonotus granulatus* (Say) Bollman.**

*Polydesmus granulatus* Say.

*Scytonotus scabricollis* C. L. Koch,—System der Myriapoden, p. 130.—Die Myriapoden II, p. 41, fig. 164.

*Scytonotus lavicollis* C. L. Koch,—System der Myriapoden, p. 131.—Die Myriapoden II, p. 43, fig. 165.

*Scytonotus granulatus* Bollman,—Entomologica Americana III, p. 46.

There can be little doubt that *Polydesmus granulatus* Say is the animal described by C. L. Koch as *Scytonotus scabricollis*. Say's description includes several statements which could not apply to any other known North American diplopod:

“*Body* with short hair, pale tinged with red beneath, and feet paler; *head* dusky with short dense hairs; *labrum* whitish; segments somewhat convex, granulated, granules rounded, or longitudinally oblong-oval, elevated, obtuse, approximate and arranged transversely in about four nearly regular series, anterior segment transversely oval, narrower than the head or second segment; *stigmata* elevated.

“Found in Pennsylvania.”

Especially diagnostic are the number and arrangement of the granules and the location of the repugnatorial pores. Like most of the old descriptions, the above is very meagre and a more detailed one will be in place.

Body 5–6 times as long as broad (fig. 65), subfusiform, narrowed very gradually cephalad, very abruptly caudad, sub-depressed, above moderately convex.

Vertex very minutely punctate, appearing smooth, rather densely hirsute with short hairs; median furrow distinct, though not deep, extending slightly more than half to the antennal sockets; on each side a very faint, somewhat arcuate, oblique line extends from the end of the median furrow to the antennal sockets, indicating sutures which join that of the median furrow; the angles included between these three lines are subequal, the lower slightly smaller than the others. These diagonal sutures should probably be looked upon as the lines of demarcation between the vertex and clypeus, as there is no trace of a suture lower down. Above the antennal sockets the vertex is prominent, while laterad from them is a sudden depression or broad groove. The disc like structure to be found just above or outside of the antennal socket in most *Polydesmidae* is here not apparent. Under good magnification the vertex furrow is seen to be occupied by minute transverse wrinkles.

Clypeus somewhat less hirsute than the vertex, prominent between the antennae, and especially on the sides below the antennal groove mentioned above; lower down the clypeus is flattened or with a broad shallow depression, and with fine transverse wrinkles. Along the lateral margins, below the prominence is a sub-plane with a sharp edge, and just above the labrum a transverse elevated one. A deep, curved incision extends from the lateral margin nearly to the antennal socket, just above the lateral prominence.

Labrum with two rows of bristles, 6-8 in the lower row, 4 in the upper; broadly and deeply emarginate, the emargination with three rounded teeth, which do not project as far as the edges of the emargination.

Antennae rather densely pilose, 2.25-2.75 mm. long, third joint slightly longer than the first two taken together; sixth joint much the thickest, all but the first and last obconic.

Mandibular stipes large, projecting laterally beyond the first segment, above and posteriorly angled (see fig. 47); exposed surface divided by sutures into 6 areas, of which 5 are triangular and 1 trapezoidal (figs. 48-49); masticatory plate elongated triangular, with numerous transverse ridges closer together towards the small end (fig. 55). One side fringed with denticulated processes (fig. 56). Under a high power the ridges are seen to be pinnately branched, and toward the small end of the plate the ridges become indistinguishable and pass gradually into a fine raised reticulation (fig. 57). Between the ridges, toward the large end the plate is perforated by numerous round openings—possibly of the salivary ducts.

Dentate lamella with four rounded teeth, the margin beyond the teeth with one or two indistinct notches (fig. 53).

Mentum pointed-cordate, slightly longer than broad, the surface tuberculate-papillose, a few short bristles near the apex (fig. 50).

Stipes three times as long as their greatest width; a transverse row of long bristles anteriorly, a median area rather sparsely covered with somewhat shorter bristles extending nearly to the proximal end of the stipes.

Cardo irregularly trapezoidal, over twice as long as broad. External process with 6-8 cones, the internal with 10-14 (fig. 51).

Lingual lamina more than three times as long as broad, with a few long bristles. Lingual lobes large, somewhat broader than long, truncate distad, 2-3 very small cones at the interior corner. Median lobe clavate, truncate or acuminate at apex, or truncate below and acuminate above; on either side, near the apex, rises a styliform process, sometimes bidentate at apex (fig. 52).

First segment sub-elliptical, more arcuate in front, about twice as broad as long, much narrower than the head or second segment; surface rough with setiferous granules of varying distinctness, sometimes the central ones are nearly obliterated, sometimes all except the posterior row.

Second segment shortest, about half as long as the first, sub-lunate, the ends longer than the middle, and embracing the first segment; surface very convex and rough with granules usually without evident regularity of arrangement.

Subsequent segments gradually longer, the anterior projection of the carinae gradually disappearing, though the anterior corner is prominent on nearly all the segments. Beginning with the fifth the posterior angle becomes more and more prominent, especially on pore-bearing segments, and on some of the caudal segments takes the form of a triangular projection from the posterior margin. The granules become more regularly arranged in five or six transverse rows; the furrow in front of the third posterior row is usually deeper than the others, and a somewhat pronounced median furrow runs from it to the anterior margin of the subsegment.

Repugnatorial pores situated in a slight depression on top of the large smooth sub-elliptical elevation at the corner of posterior segments and nearer the middle of the lateral edge of the anterior.

Lateral carinae thick, the edges granulate-serrate, smooth below; the granules usually larger and irregularly arranged.

Supplementary margin (fig. 58) finely pectinate, the teeth transparent, lance-like, simple or with a small tooth on one side, rarely on both.

Anterior subsegments densely and minutely punctate; between the subsegments a somewhat abrupt constriction.

Last segment the dorsal surface rough with spine-like, setiferous tubercles, not arranged with regularity; conic, decurved, truncate at apex, and with four small pits from each of which rises a long bristle. On each side above the apex is a larger tubercle (fig. 67).

Anal valves smooth or faintly wrinkled, the margins compressed, elevated, a groove on either side, in which is located two setigerous tubercles, one near the middle, the other near the upper corner.

Pre-anal scale much broader than long, sub-triangular with the apex broadly truncate or rounded, on each side a tubercle from which rises a long bristle, appressed to the anal valves.

Color horn-brown, some specimens with a decided tinge of cherry red, others dirty white; extremities of antennae and legs colored like the body, sometimes darker and sometimes lighter; ventral surface and basal joints of legs and antennae pale.

Length 12-14 mm.; width 1.5-1.75 mm.

*Habitat*: Among leaves and rotting debris in moist deciduous woods of Eastern North America. Pennsylvania (Say); reported by Dr. Wood from Pennsylvania, Michigan and Canada; Mr. Bollman records it as abundant in Indiana. The writers have collected specimens in the following places: Syracuse, N. Y., and several places in the vicinity, Tully, Marcellus, Jamesville, Clyde and Wolcott, Wayne county, N. Y.; Lebanon, Pa.; Washington, D. C., and on the Virginia side of the Potomac near Washington.

The species is seldom abundant, but in the right locations a few specimens are usually to be found. At Lebanon, Pa., a large number of individuals were found among rotting leaves piled up during high water near a brook. About a hundred specimens form the basis of the present study. The proportions of the sexes seem to be about equal.

*Larval form*: Six-legged larvæ (fig. 70) of this species were found near Wolcott, Wayne county, N. Y., in May of the present year, among leaves on a wooded hill-side. They are sluggish in their movements and might be mistaken for Lipuræ. In color they are pure white. Like the larva of *Polydesmus* in the six-legged conditions they have seven segments, with a repugnatorial pore on the fifth. The first pair of legs is apparently attached to the first segment. The legs seem to be six-jointed, as in the adults, but the antennæ have only four<sup>1</sup> joints. There are four olfactory cones (also agreeing with *Polydesmus*<sup>2</sup>), and are proportionally longer than in the adult. The third joint has on one side a single marginal row of the finger-like sense-organs found on the sixth joint of the adult. The fourth joint has the transparent cones and long hair of the seventh joint of the adult. This

<sup>1</sup>The antennæ of the Helminthomorpha have, in reality, eight joints, although nearly always reckoned as seven-jointed, the terminal being reduced to a cap or disk bearing the four olfactory cones. Sometimes this is retracted into the end of the seventh joint. In the larva under examination the terminal is not so rudimentary as it afterward becomes. From Rath's diagram (Beiträge zur Kenntniss der Chilogathen, pl. 2, fig. 24) it appears that this is to an even greater extent the case with the European *Polydesmus complanatus*.

<sup>2</sup>Heatcote (Philos. Trans. Royal Soc., London (1888), pl. 27, fig. 3) figures the antennæ of a six-legged *Iulus terrestris* as 7-jointed (8 joints with the terminal) and two olfactory cones. This difference is certainly noteworthy if the figures referred to prove correct.



indicates that the additional joints are either intercalated between the others or at base, probably the latter, for the second joint of the larval antenna also has some of the finger-like sense-organs, like the fifth joint of the adult.

There are five pectinate lamellæ, the number being constant in the three individuals of which the mandibles were examined.

The styliform processes of the median lobe of the gnathochilarium are much larger proportionately than in the adult, and are tridentate as in *Chordeumidæ*. The cones of the processes of the stipes are very few.

The greatest difference between the young and the adult is that the former is covered with clavate, *barbed*, bristles (fig. 69). Such have been reported as occurring on the embryo of *Strongylosoma guerini*, but do not seem to have been noticed at a more advanced stage. Both Rath and Packard have observed the six-legged larva of *Polydesmus*,<sup>1</sup> and both report the bristles as clavate, but do not mention that they are barbed, though the importance of this latter fact would have doubtless been realized on account of the attempt to connect the Archepolypoda with the modern Diplopoda by means of the barbed hairs of *Polyxenus*. On the larval *Scytonotus* the hairs are more clavate dorsally, on the sides and below becoming more and more of the usual shape.

The four bristles of the apex of the last segment are also in notable contrast to those of the adult, both in their great size and large pedicels. All the hair-structures of the larva have more or less of a raised base, except those of the legs and antennæ.

The larval claw is distinctly bifid, though the inside hamus is very small (fig. 71). In the adult an exceedingly minute rudiment of this may be found under a quarter-inch objective.

The larvæ measure 1.25 mm. in length, and .4 mm. in width. A considerable number were found together, and they were probably newly hatched.

<sup>1</sup> Dr. A. S. Packard has reported (*American Naturalist*, 1886, p. 651) the six-legged larva of *Polydesmus canadensis* from Florida, as having eight segments. We have not seen *canadensis* from the South. Other similar species replace it there.

*Comparative Differences Between the Sexes.*

1. The antennæ of the female are shorter and more clavate than those of the male (cf. figs. 40 and 41).

2. The legs of the female are about one-third shorter, and about half as thick as those of the male (cf. figs. 1-29 and 30-39). These differences are sufficient to make the sexes distinguishable at sight, the female appearing much more slender, though the diameter of the body is not less than in males.

The size and shape of the first pair of legs is nearly the same in the two sexes (cf. figs. 1 and 3), and the coxal joint is in both cases densely papillose, except on its posterior face. The difference in size between the sexes begins to appear in the second legs, whose coxæ are papillose on the outer face in both sexes. Occasionally the coxæ of other male legs show a slight roughening of the outer face.

3. The pedigerous laminae of females are much broader than those of males (fig. 62), a partial compensation for the shortness of the female legs.

*Secondary Sexual Characters of Males.*

1. Legs 13-20,<sup>1</sup> inclusive, are more or less conspicuously different from the others, some of the joints being more crassate and otherwise modified. The legs increase in size gradually from the 1st to the 13th, the penultimate joint of which is much inflated, as is also that of the 14th, 19th and 20th, and to a less degree that of the 15th, 16th, 17th and 18th. The 21st legs are apparently different from the 12th. The legs behind the 21st pair are gradually more slender and slightly shorter. In the legs which are most modified, the 13th, 14th, 19th and 20, the last joint is shorter than the normal, the penultimate being hypertrophied.

2. The ventral face of the distal portion of the second joint is papillose on the 18th, 19th and 20th legs. The papillæ are fewest on the 18th and most numerous on the 19th, on which also the papillose surface is considerably elevated, the same condition obtaining on the 20th, but to a less degree.

<sup>1</sup>The drawings of the male legs are numbered as they occur on the animal.

3. The ventral face of the third joint is more or less papillose on legs 3-7, 9-12, and 18-29. The papillæ are few on legs 3-12, and are confined to the distal part of the joint. On the 18th legs there is a papillose area near the middle of the joint, while on the 19th and 20th the roughened surface is large and prominent, with more scattered papillæ covering a large part of the ventral face of the joint. On legs 21-29 the papillæ are about the same as on 3-12, becoming gradually fewer and smaller. The absence of papillæ on legs 13-17 is noteworthy, considering the fact that these legs are much modified in other respects.

4. The third joint of legs 19 and 20 is stouter than that of the others and has its distal margin noticeably more oblique, conditions probably correlated with special roughness of the joints of these legs.

5. The fourth joint is papillose on its inner face on all the legs except numbers 1 and 13-17, which have the third joint also smooth.

6. The fourth joint of legs 19 and 20 is shorter, broader, and more papillose than the others.

7. On legs 13-18 and 21-23 the apical margin of the fourth joint is very oblique, probably to make it possible to flex the enlarged fifth joint. Thus the oblique margin of the *fourth* joint of these legs corresponds functionally to that of the *third* joint of legs 19 and 20, or in other words, the fourth joint of legs 19 and 20 has become a part of the fifth, while that of legs 13-18 and 21-23 is functionally more like a part of the third. The peculiar form and the abundance of papillæ on the fourth joint of legs 19 and 20 give force to this suggestion. Transitions between the two types of arrangement are not wanting, for legs 18 and 21-23 gradually shade off into the normal form. When, however, we compare 13 with 20 there can be no doubt that the necessity of special provision for flexing the abnormally crassate joints has been met in two different ways.

8. The ventral face of the fifth joint of all the legs is papillose, except that the roughening is nearly or quite obsolete on the first pair. On legs 13-20 the roughened surface is much more extensive.

9. Legs 13-20 have the ventral face of the fifth joint much inflated, most on the 13th, and slightly less on the 14th, 19th and 20th. The prominent papillose surface is much longer on the

19th and 20th than on the other legs, this being allowed by the conformation of the third and fourth joints.

10. On the posterior face of the distal part of the fifth joint of the 13th–18th legs is a protuberance, very large and curved on the 13th, gradually smaller on the 14th, 15th, 16th and 17th, inconspicuous or wanting on the 18th.

11. Rising from the *anterior* face of the distal part of the 19th and 20th legs is a similar large protuberance.

12. On the ventral side of the sixth joint of all the legs except the 1st and 2d pairs there are three or more rows of 11–14 coarse, rounded, conic teeth, each of which is extended on the distal side into a long bristle. Similar structures occur on the males of *Polydesmus*, the tubercles being larger and less numerous.

#### *Secondary Sexual Characters of Females.*

1. The coxæ of 2d pair of legs are ventrally inflated and densely papillose, and are separated by a median prolongation of the pedigerous lamina.

2. The pedigerous lamina is prolonged between the legs of the third pair, and is medianly deeply lobed and papillose.

3. The first, second and third joints of all the legs are more or less papillose on the *dorsal* face, the papillæ being more and more obscure on the legs of the last few segments.

4. The carinæ of segments eight and nine, and usually of one or two adjacent segments are much reduced or entirely wanting, causing the female to appear much more slender. The reduction or absence of carinæ is no doubt correlated with the special modification of the 13th and immediately following legs of the male, for in copulation these legs clasp the segments mentioned.

The above secondary differences between the sexes are in many respects the greatest known to occur in the present sub-class. The genitalia of *Polydesmidæ* are, of course, much less complex than those of the other families of the *Helminthomorphous* group, but one pair of legs being transformed for this purpose, while in the *Iulidæ* two are used, and in the *Chordeumidæ* sometimes as many as four pairs. In the *Chordeumidæ*, also, the secondary modifications are in some cases very considerable, but are almost entirely confined to the legs in front of the genitalia, and special adaptations of legs far behind the genitalia do not appear. It is,

however, in comparison with other Polydesmidae, that the high degree of specialization of *Scytonotus* becomes apparent.

To have the legs of males larger and stronger than those of females is a character general, if not universal, in Polydesmidae. There are, too, among the different genera different contrivances to assist in copulation, for example, in *Fontaria* the claw of the male leg is proportionally much larger and longer than in the female, and strongly decurved (figs. 44-45), while in *Oxydesmus* (figs. 42-43) the claw is decidedly shorter in the males.

Some of the special structures, such as the tuberculation of the distal joint of the legs of males, *Scytonotus* has in common with *Polydesmus* and *Paradesmus*,<sup>1</sup> but in none of the genera is there known to occur any such abrupt and apparently abnormal modifications of shape and structure as are exhibited by the legs of the 13th-20th pairs, much less any corresponding adaptation of the female as the atrophy of the carinae; in fact, no similar case seems to have been noted among the Diplopoda.

Huntington, N. Y., 15 August, 1893.

<sup>1</sup> In *Polydesmus* the tubercles are more knob-like than in *Scytonotus*, they appear on the three distal joints of the legs, and are seta-tipped, as in *Scytonotus*. In *Paradesmus* the tubercles are to be found on four joints, are conic, and without setae.

## EXPLANATION OF THE PLATES.

### PLATE VI.

#### *Scytonotus granulatus.*

Figs. 1-21.—Legs of the male, the number of the figures corresponding to that of pair.

Fig. 8.—Genitalium of male, median face.

Fig. 13a.—The 13th leg, joints 3-5, posterior face.

Fig. 13b.—The same, with joint 6, dorsal face.

PLATE VII.

**Scytonotus granulatus.**

Figs. 22-29.—The remaining male legs.

Figs. 30-35.—Legs of the female pairs, 1-6 respectively.

Figs. 36-39.—Legs of the female pairs, 26-29.

Fig. 40.—The antenna of the male.

Fig. 41.—Antenna of female.

**Oxydesmus sp.**

Fig. 42.—Claw of male.

Fig. 43.—Claw of female.

**Fontaria trimaculata.**

Fig. 44.—Claw of male.

Fig. 45.—Claw of female.

PLATE VIII.

**Scytonotus granulatus.**

Fig. 46.—Labrum, showing the two rows of bristles.

Fig. 47.—Parts of first segment, vertex and mandibular stipes. Superior-posterior view.

Fig. 48.—Mandibular stipes, lateral face.

Fig. 49.—Same, ventral face.

Fig. 50.—Gnathochilarium, with hypostoma.

Fig. 51.—Same, distal part, interior face.

Fig. 52.—The median lobe of gnathochilarium, with styli-form processes.

Fig. 53.—Mandible.

Fig. 54.—First four segments of the female, ventral view. The head has been removed. The pedigerous laminae of the first and second pairs of legs are free. On the third segment are the female genitalia, their aperture at the lateral edge of the diagram.

Fig. 55.—The masticatory plate.

Fig. 56.—Fringed processes from the edge of the masticatory plate near the base, much magnified.

Fig. 57.—The apex of the masticatory plate, much magnified.

Fig. 58.—The supplementary margin.

Fig. 59.—End of antenna, much magnified, showing the sense-organs of the three distal joints.

## PLATE IX.

**Scytonotus granulatus.**

Fig. 60.—Seventh segment of male, ventral face, showing the genitalia *in situ*.

Fig. 61.—Same, the distal joints of genitalia bent downward (backward), showing the concavities of the expanded basal joint, in which the distal joints are partially concealed.

Fig. 62.—Diagrammatic cross-sections of the eighth segment of the two sexes.

**Polydesmus canadensis.**

Fig. 63.—Diagrammatic cross-sections of the two sexes.

**Scytonotus granulatus.**

Fig. 64.—Three terminal segments, with anal valves and anal scale, lateral view.

Fig. 65.—Dorsal view of entire animal.

Fig. 66.—Segments 6-11 of female, showing the atrophied carinæ of the eighth and ninth segments.

Fig. 67.—Terminal segments ventral view.

Fig. 68.—Terminal segments of the six-legged larva.

Fig. 69.—Barbed hairs from the six-legged larva.

Fig. 70.—Six-legged larva.

Fig. 71.—Claw of same.

IX.—*The South American Cat-fishes Belonging to Cornell University.\**

BY EDWARD M. KINDLE.

Read October 22, 1894.

Some years ago the late Charles Frederick Hartt made a collection of fishes in Brazil, which he gave to Cornell University. Through the courtesy of Dr. B. G. Wilder this collection was transmitted to Dr. Eigenmann for identification. The cat-fishes in it were turned over to me for determination. In the identification of these I have used the "Revision of the South American Nematognathi," by C. H. and R. S. Eigenmann. I am indebted to Dr. Eigenmann for the use of his library and for assistance in the identification of doubtful species.

The collection contains nineteen genera and twenty-seven species, distributed among three families: Siluridæ, Loricariidæ, Callichthiidæ, and their sub-families. It has yielded two new species. One of these belongs to the genus *Hassar*. The name *wilderi* is proposed for it in honor of Prof. Wilder. It is represented by four specimens from the Tocantins River. The other new species belongs to the genus *Hemiancistrus*. It has been named *longipinnis*, in reference to the long dorsal.

The collection is mainly from the Amazon and its tributaries. The fish fauna of the Amazon is very similar to that of the Orinoco on the north and the LaPlata on the south. This is explained by the fact that these three river systems are connected through their tributaries. The only genus which was considered peculiar to the LaPlata fauna is *Cochliodon*. I find this genus represented in the collection by four specimens from

\* Contributions from the Zoölogical Laboratory of the Indiana University. No. IV.



Marajo, near the mouth of the Amazon; there is, therefore, now no genus known to be peculiar to the LaPlata. These specimens which belong to the species *Cochliodon cochliodon* are of particular interest, inasmuch as the genus and species has heretofore been known only from the types in the Museum of Vienna.

From the Rio San Francisco there are but four specimens—all of a species common to the mouths of the east coast rivers of Brazil. The rivers of south-eastern Brazil, which Dr. Eigenmann has shown to have a fish fauna distinct from that of the Amazon on the north and the LaPlata on the south, are not represented in the collection.

Lake Titicaca is represented by a single specimen, *Pigidium rivulatum*, collected by Mr. S. Garman. This species with *Rhamdia quellen* are the only cat-fishes found in Lake Titicaca. Both of these are alpine forms characteristic of the mountain streams of the Peruvian Andes.

## SILURIDÆ.

### PIMELODINÆ.

1. **Rhamdia sebæ kneri** (Steind.) One specimen. Marajo on Tocantins.
2. **Pimelodella cristatus** (Müll. & Troch.) One specimen, Brazil.
3. **Pimelodus clarias** (Bloch.) 1754, 1755, 1756, 1738, 1739, Para.
4. **Hemisorubim platyrhynchos** (Cuv. & Val.) 1750, 1751. Para.
5. **Pseudoplatystoma fasciatum** (Linn.) 1716. Para.

### DORADINÆ.

#### *Analysis of the genera of Doradinæ.*

- a. Barbels all simple.
- b. Eye in the anterior portion of the head; snout depressed; teeth well developed.
- c. Humeral processes much shorter and weaker than the coracoid process. No adipose dorsal; gill openings greatly reduced. Clavicle and coracoid forming a large shield below.

**Physopyxis** Cope.

- cc. Humeral process much longer and stronger than the coracoid process ; lateral plates not meeting on the back in front of a point midway between the dorsal fins..... **Doras** Lacépède.
- bb. Eye in the middle or behind the middle of the head.  
**Oxydoras** Kner.
- aa. Barbels not simple, maxillary and sometimes mental barbels fringed. Eye large ; teeth rudimentary or absent.
- d. Lateral scutes well developed from the dorsal plate backward.  
**Hemidoras** Bleeker.
- dd. Lateral scutes rudimentary on the anterior half of the body or none ; a subdermal stay connects the dorsal plate with the tip of the humeral process, a similar one connects the tip of the dorsal with the post-temporal, to which the stay is firmly joined. Snout long and pointed ; head compressed ; lower profile straight, upper profile strongly arched. Humeral process broad, rounded behind. Numerous pores in the axil giving a sieve-like appearance.  
**Hassar** E. & E.
6. **Doras dorsalis** Cuv. & Val. 1702, 1729, —. Three specimens.
7. **Doras spinosissimus** E. & E. 1729. Brazil.
8. **Doras weddellii** Castl. 1706, 1707, 1708, 1709, 1727. Marajo.
9. **Doras costatus** (Linn.) 1747. Trocero on Tocantins.
10. **Oxydoras niger** (Val.) 1700, 1701, 1719. Para.

*Analysis of the Species of Hassar.*

- a. Dorsal with a conspicuous black spot.
- b. Scapula covered with skin ; black spot on dorsal not extending to upper margin of membrane. .... **orestes** (Steind.)
- bb. Scapula granular ; black spot extending to upper margin of membrane ..... **wilderi** sp. nov.
- aa. Dorsal without black spot ; dusky at tip. .... **affinis** (Steind.)
11. **Hassar orestes** (Steind.) 1733, 1734, 1735, 1736, 1737, 1741, 1742, 1743, 1744, 1745, 1746, 1747, 1748, Itaituba, Brazil.
12. **Hassar wilderi** sp. nov.

Body subterete, highest below the dorsal spine, tapering backward, the depth everywhere greater than the width. Head rather long ; higher than wide, snout pointed, the profile not very steep from dorsal spine to the eye, thence much steeper forward, the space in front of the anterior nostril slightly concave. Bones of the head finely granular.

Supraclavicle with its distinct dermal ossification not meeting the humeral process, its surface finely granular. Fontanel narrow, as long as the eye, its center over the pupil ; a bridge across its posterior half.

Eye large, placed high and far back midway between posterior margin of the dorsal plate and tip of the snout, measuring to the orbital rim  $1\frac{2}{3}$

to  $2\frac{1}{4}$  in snout, 3 to  $3\frac{3}{4}$  in the head, the interorbital width about  $1\frac{1}{2}$  in the orbital diameter.

Maxillary barbels reaching the gill openings, or beyond, except in the old; all the barbels united by a membrane; the mental barbels short, their bases thickened and covered with short fleshy cirri.

Snout covered with skin; posterior nares about equidistant between the anterior nares and the eye, the anterior nares about equidistant between the eye and tip of the snout; mouth very small, wholly inferior; a very small patch of villiform teeth on each intermaxillary, a larger patch on each dentary bone. Gill openings rather wide, the isthmus about equal to the orbital diameter. Coracoid bones covered with skin.

Lateral scutes low, highest above the anal, their height about  $\frac{1}{2}$  the orbital diameter, gradually becoming smaller each way. Each scute with a median hook.

Distance of the dorsal fin from the snout  $2\frac{1}{3}$  to  $2\frac{1}{2}$  in the length; dorsal spine  $1\frac{1}{3}$  to  $1\frac{1}{4}$  in the head, serrate on both margins, most coarsely on the inner, the sides triate. Interdorsal space 3 to  $3\frac{1}{2}$  in the length.

Caudal fin forked, its rays leathery; accessory rays 10 or 11, the last forming a small plate above and below on the caudal peduncle, the longest rays  $1\frac{1}{2}$  to  $1\frac{1}{3}$  in the head; upper lobe of caudal longest.

Anal slightly emarginate, its highest rays 2 to  $2\frac{1}{2}$  in the head.

Ventrals not reaching the anal, about two in the head.

Pectoral spine strong, serrate on both margins, most coarsely on the inner; sides striate.

Numerous small pores in the axil and beneath the lower margin of the humeral process as in the other species of this genus. Humeral process broad and strong, reaching little beyond the middle of the pectoral spine, its surface striate.

Color dark above, lighter below; dorsal fin with a black spot on the upper half extending from the spine to the third ray. Pectorals and anal usually with minute dots. Pectorals dusky above, lighter below. 1703, 1704, 1705, —.

Trocera on Tocantins, Brazil. Four specimens. Collected by C. F. Hartt.

#### AUCHENIPTERINÆ.

13. **Trachycorystes striatulus** (Steind.) Six specimens. 1710. 1711, 1712, 1713, 1714, —. Rio San Francisco and Marajo.

#### AGENEIOSINÆ.

14. **Ageneiosus valenciennesi** Bleeker. 1730. Brazil.

#### PYGIDIIDÆ.

15. **Pygidium rivulatum** (Cuv. & Val.) One specimen. Lake Titicaca.

# LORICARIIDÆ.

## LORICARIINÆ.

16. **Loricaria laeviuscula** Cuv. & Val. 1696, 1697. Itaituba, Brazil.

17. **Loricaria stübelii** Steindachner. 1698. Two specimens. Marajo.

## PLECOSTOMINÆ.

18. **Plecostomus emarginatus** Cuv. & Val. 1690, 1694. Trocero on Tocantins (?).

19. **Plecostomus plecostomus** (Linn.) 1687, 1688, 1689, 1695, 1678, —, —. Seven specimens. Marajo on Tocantins.

### *Key to the Species of Hemiancistrus.*

- a. Anal rays four. Head depressed, without prominence in the occipital region, as broad as long; its length 3 in the total. Diameter of the eye  $2\frac{1}{2}$  in the interorbital region. Caudal forked, lobes pointed.  

**trinitatis** (Günth).
- aa. Anal rays five.
  - b. Interorbital very broad, its width five times the diameter of the eye; eye 10 in the head. Head much depressed, longer than broad. Interoperculum contains three kinds of spines, about twelve stiff slender spines slightly hooked, surrounded by a ring of setiform spines. The pectoral fins extend beyond the middle of ventral, and ventral beyond the anal.....**heteracanthus** (Günth).
  - bb. Interorbital moderate, its width containing  $1\frac{1}{2}$  to 3 times the diameter of the eye.
    - c. Body with light longitudinal bands; fins with bluish cross bands. Occiput with a slight prominence. Diameter of eye  $2\frac{1}{3}$  in interorbital.....**itacua** (Val).
    - cc. Body without light longitudinal bands; fins without bluish cross bands.
      - d. Interorbital with a pair of shallow grooves. Eye 5 in the head, more than one-half of interorbital. Head but little depressed. Scutes of body without keel, but with vertical series of spines; the anterior scutes with one series, the middle with two, and the posterior with three series. L. l. 23.  

**megacephalus** (Günth).
      - dd. Interorbital without a pair of shallow grooves.
        - e. Caudal obliquely truncated.
        - f. Pectorals extend to base of ventrals.

- g. Scutes of body without keels. Head much depressed, a little longer than broad. Occipital and nuchal regions flat. Snout broad, granulated except at tip. Diameter of eye equals  $\frac{1}{3}$  of the interorbital. **schomburgki** Günth.
- ff. Pectorals extend to middle of ventrals almost.
- h. Scutes of body with prominent serrated keels. Head large, broader than long,  $3\frac{1}{3}$  in total. Orbit elevated. Interorbital rather concave. Eye large, its diameter equals distance to posterior edge of the head and more than  $\frac{1}{2}$  of interorbital. Base of dorsal equals its distance from caudal. Pectoral ray covered behind with setiform spines.....**medians** (Kner).
- hh. Scutes of body without keels. Head large, little longer than broad. Base of dorsal very long, equals nearly twice the distance from the caudal to the dorsal. First ray of pectoral covered with small hooked spines toward the tip. Eye  $2\frac{1}{7}$  in interorbital,  $5\frac{2}{3}$  in head. Dorsal and caudal fins and body covered with small white spots.....**longipinnis** sp. nov.
- ee. Caudal not truncated, lobes of equal length.
- i. Lower lobe of caudal strongest. Body covered with round black spots. Head not depressed, broad as long, length in total  $3\frac{1}{4}$ . Interoperculum with about 16 setiform spines, longest 3 in the head. Pectoral reaches nearly to middle of ventral. Eye 2 in interorbital. L. 1. 26.  
**obligospilus** (Günth).
- ii. Upper and lower caudal lobes of equal strength. Body without spots. Head short and high. Width at opercles one ocular diameter less than greatest length. Preopercle with numerous slender spines. Orbital diameter as long as barbel,  $2\frac{1}{2}$  to  $3\frac{1}{2}$  in snout, 5 to  $6\frac{1}{4}$  in head, 2 to  $2\frac{1}{2}$  in interorbital.....**vittatus** (Steind).
- aaa. Anal rays six.
- j. Dorsals 1-7.
- k. Lateral scutes keeled, caudal obliquely truncated.
- l. Eye 3 in interorbital; head with prominence on occiput. Keels on lateral scutes serrated. Head much depressed, length equals  $\frac{1}{3}$  of total. Keels on lateral scutes serrated. Lower lobe of caudal  $\frac{1}{3}$  longer than upper. Interopercle with 15-18 setiform spines. L. 1. 25-26.....**scaphirhynchus** (Kner).
- ll. Eye  $1\frac{1}{2}$  in interorbital. Head without prominence.
- m. Dorsal a little longer than high. Snout granulated except at tip. Upper surface of head and body with rather irregular yellowish spots.....**pictus** (Kner).

mm. Dorsal much longer than high ; color brown.

**brachyurus** (Kner).

kk. Lateral scutes not keeled ; caudal forked.

n. Scutes striated.

Eye  $2\frac{1}{2}$  in interorbital. Pectoral spine extends beyond the base of ventral fin. Lobes of caudal much pointed.

**guacharote** (Cuv. & Val).

nn. Scutes spiny, spines in lines ; eye 3 in interorbital. Post humeral ridge obtuse. Dorsal fin nearly as high as long. Lower lobe of caudal longest. Color olive. Four or five black spots along each dorsal ray.....**mystacinus** (Kner).

jj. Dorsal 1-8.

o. Eye 6 in interorbital, 15 in head. Scutes with granulated keels. Bristles studding first ray of pectoral spine at middle very long, shorter at base. Snout very obtuse and rounded. Granulated crests on three intermediate rows of scales. Width of head  $3\frac{3}{4}$  in total length, greater than length of head. Lobes of caudal pointed.....\***histris** (Cuv. & Val).

oo. Eye less than 6 in interorbital, and less than 15 in the head. Keels on scutes not granulated.

p. Black spots on all parts of body. Head, scutes, and outer fin rays covered with spines. Pectoral not longer than the head. Snout depressed and rather long.....**spinus** (Castelnau)

pp. No black spots.

q. Pectoral spine covered with long hook-like bristles and extending somewhat beyond the base of the ventral. Snout broad and elongate. Interopercle with about 15 setiform spines. Scutes of body covered with spines, longest along the middle. Head large and depressed, equals 3 in the body.  
**serratus** (Cuv. & Val).

qq. Pectoral spine covered with short, hook-like bristles, extending to second third of ventral. Ventral spine as long as that of pectoral fin. Eye  $2\frac{1}{5}$  in interorbital, 8 in head. Scutes of body each with three or four prominent spines. Each jaw has six or seven stoutish teeth on each side ; each has a lobe on the outer side rather distinct from the flat apex.....**fordi** (Günther).

20. **Hemiancistrus vittatus** (Steind.) One specimen Marajo.

21. **Hemiancistrus longipinnis** sp. nov.

Body heavy forward, somewhat compressed. Head broad, breadth about equal to length and nearly twice the depth. Occipital shield shaped, bordered by a single nuchal plate. Plates in front of and below

\* *H. histris* probably belongs here. Not having access to a full description, or specimen, I am unable to learn the number of anal and dorsal rays.

the eyes loosely connected, so that these parts are soft. Interorbital region flat. An obtuse ridge extends from the margin of the interorbital nearly to the snout. A similar ridge extends from the orbit slightly past the nares. Distance between the nares equal to length of orbit. Head and snout hispid. Eye  $2\frac{1}{7}$  in interorbital,  $3\frac{1}{3}$  in snout,  $5\frac{2}{3}$  in the head. Length of head in body about 3.

Dorsal long, length of base equals six times the distance between the adipose and dorsal.

Caudal obliquely truncated; lower lobe produced.

Pectoral spine strong, reaching nearly to middle of ventrals, covered with short recurved hooks.

Ventral surface with a patch of granulated scutes opposite the base of each pectoral spine and larger patches posterior to these along the sides; a few scutes are scattered over the posterior part of the ventral region back of and between the ventrals, also a round patch between the pectoral patches.

Lower lip with numerous papillæ, not notched. Barbels equal  $\frac{1}{2}$  of interorbital diameter.

Preopercle with about 35 hooked spines; the longest equals about one and a half times the orbital diameter.

Teeth with tips divided into nearly equal lobes.

Rays and connecting membrane of dorsal covered with numerous small white spots; the other fins and the body similarly, but less distinctly spotted. L. 1. 25; D. 1-7; A. 5; V. 6. Length 20 cm.

Trocera on Tocantins. One specimen.

22. **Cochliodon cochliodon** Kner. 1677, 1681, 1686, —. Four specimens. Marajo, Brazil.

23. **Panaque nigrolineatus** (Peters). 1691. Brazil.

24. **Pterygoplichthys pardalis** (Castelnau). 1683, 1693. Brazil.

25. **Ancistrus cirrhosus dubius** E. & E. One specimen. Brazil.

26. **Ancistrus leucosticus** (Günther). One specimen. Lower Amazon.

#### CALLICHTHIIDÆ.

27. **Callichthys callichthys** (Linn.). 1667. Trocera on Tocantins.(?)

28. **Hoplosternum littorale** (Hancock). 1731, 1732. Brazil.

29. **Hoplosternum thorocatum** (Cuv. & Val.). 1668. Itaituba, Brazil.

X.—*The South American Characinidæ Collected by Charles Frederick Hartt.\**

BY ALBERT B. ULREY.

Read October 22, 1894.

The present paper is based on the Characinidæ collected by Charles Frederick Hartt in Brazil. The collection was made during the summer of 1870 and presented to Cornell University, the material remaining unidentified until the present. Some of the species in this list have been described by Eigenmann and Eigenmann from the collections of the Thayer expedition at Harvard University since this collection was made. There still remain seven new species, four of them belonging to the genus *Tetragonopterus*.

For convenience of identification I have made keys to the the genera *Cheirodon*, *Aphiocarax* and *Tetragonopterus*. I have not had a sufficient number of specimens to determine the extent of variations in these genera. Some of the species will probably be found to be synonyms, but on account of the insufficient material at my disposal, and the incompleteness of many descriptions these species have for the present been retained. A natural grouping of the species is not claimed for the keys, the foremost purpose being to facilitate identification. I have, however, used those characters which are of most value in determining relationships when such were known and could readily be used in identification.

It is hoped that the keys and appended synopsis will materially reduce the labor of identifying species of *Tetragonopterus*. I can scarcely hope that they are entirely free from errors, and in some parts they must of necessity be imperfect. It is believed,

\* Contributions from the Zoölogical Laboratory of the Indiana University, under the direction of Carl H. Eigenmann, No. VIII.



however, that they will make less formidable the task of unraveling the numerous tangled places in the Tetragonopterinae when a collection of sufficient material is at hand to attempt this.

I am indebted to Dr. and Mrs. Eigenmann for much of the synonymy which they had collected for a revision of the Characinidæ and which they placed at my disposal, and also for the free use of their extensive library on South American Fishes.

The specimens examined belong to the Museum of Cornell University. Series of the duplicates have been deposited through Dr. B. G. Wilder in the museums of Indiana University and of Leland Stanford University.

#### ERYTHRININÆ.

##### 1. **Macrodon malabaricus** (Bloch).

Eigenmann and Eigenmann. Proc. Cal. Acad. Sci., 2d Ser., II., 102, 1889; Eigenmann, Ann. N. Y. Acad. Sci., 1894 (Rio Grande do Sul).

Rio das Velhas, four specimens; Brazil, four; Marajo, two; Braret,\* two; Bahia, one.

These specimens show the usual variations of this species in degree of light or darkness due to the different localities, the color markings, canine and palatine teeth, lingual patches and scales in the lateral line.

##### 2. **Erythrinus unitaeniatus** Spix.

Eigenmann and Eigenmann. Proc. Cal. Acad. Sci., 2d Ser., II., 105, 1889.

Brazil, two specimens.

##### 3. **Erythrinus erythrinus** (Bloch & Schneider).

Eigenmann and Eigenmann, Proc. Cal. Acad. Sci., 2d Ser., II., 107, 1889.

Fall of Rio Tapajos, ten specimens; Lower Amazon, four specimens.

The humeral spot is band-like; the caudal spot ocellate, a whitish oblique bar on the hinder part of the dark brown opercle.

##### 4. **Pyrrhulina semifasciata** Steindachner.

Eigenmann and Eigenmann, Proc. Cal. Acad. Sci., 2d Ser., II., 110, 1889.

Para, Brazil, fifty specimens; Brazil, one specimen.

The intermaxillary has three series of teeth; the middle row strongest at the middle of the mouth, the inner row of 6 or 7 small teeth some distance from the second, pointing inward.

\*The name Braret occurs on many labels; so far I have not been able to determine whether it is a locality or the name of a collector.

This inner row of teeth is not mentioned by Steindachner or Eigenmann and Eigenmann, but from the fact that all the other characters agree so closely, and that I was able to discover them only with the compound microscope and direct sunlight, I infer they were overlooked. The dark band does not extend much or any beyond the opercle.

5. **Pyrrhulina nattereri** Steindachner.

Eigenmann and Eigenmann, Proc. Cal. Acad. Sci., 2d ser., II., 112, 1889.

Lower Amazons. Three specimens.

### CURIMATINÆ.

6. **Curimatus g ntheri** Eigenmann and Eigenmann. Annals N. Y. Acad. Sci., IV., 15, 1886.

Braret, two specimens ; Brazil, one specimen.

7. **Curimatus microcephalus** Eigenmann and Eigenmann. Annals N. Y. Acad. Sci., IV., 15, 1889.

Itaituba, six specimens ; Braret, five specimens.

8. **Curimatus plumbeus** Eigenmann and Eigenmann. Annals N. Y. Acad. Sci., IV., 17, 1889.

Para, four specimens.

9. **Curimatus isognathus** Eigenmann and Eigenmann. Annals N. Y. Acad. Sci., IV., 20, 1889.

Para, two specimens ; Marajo, two specimens ; Tocantins, one specimen ; Trocera on Tocantins, four specimens ; Brazil, six specimens.

10. **Curimatus cyprinoides** (Linna us).

Eigenmann and Eigenmann, Annals N. Y. Acad. Sci., IV., 21, 1889.

One specimen from Trocera on Tocantins.

11. **Curimatus sp.?**

Marajo, five specimens in bad condition.

12. **Prochilodus vimboides** Heckel in MS.

Kner. Denkschr. Wien. Acad. 1858, XVII., p. 12, taf. 2, fig. 4 ; G nther, Cat. Fish. Brit. Mus., V., 294, 1864 ; Steind., S sswf. S d stl., Bras., 33, 1874 (Rio Parahyba ; Rio Mucuri ; Rio Muriahe ; Rio Doce) ; Eigenm. & Eigenm., Proc. U. S. Nat. Mus., XIV., 48, 1891.

Brazil, one specimen partially macerated. Head  $3\frac{3}{4}$ , depth 3, scales  $5\frac{1}{2}$ –35–5.

13. **Prochilodus brama** Cuv. and Val.

Cuv. and Val. XXII., 82 ; Castein. Anim. Amer. Sud. Poiss, 62, pl. 31, fig. 2, 1855 (Tocantins in province Para) ; G nther, Cat. Fish. Brit. Mus. V., 296, 1864 ; Peters Mb., Ak. Wiss. Berl., 1877, 472 (Calobozo), Eigenm. & Eigenm., Proc. U. S. Nat. Mus., XIV., 48, 1891.

Body rather deep, compressed, the dorsal outlines rising rapidly to the dorsal fin. Head wide, its greatest width three-fifths of its length. The upper lip projects somewhat beyond the lower, snout  $3\frac{1}{2}$  in the head. Eye  $1\frac{1}{2}$  in the interorbital space,  $2\frac{7}{8}$  in the head and  $\frac{7}{8}$  in the snout. Dorsal fin high, marked with black spots arranged in several irregular bands. The caudal fin is marked with three oblique dark bands on each lobe. The anal not evidently marked, the three anterior rays spinous.

Color silvery, the upper part of the body darker. The scales closely imbricated, the exposed part deeper than long. The upper part of each scale darker colored than the lower part, thus forming alternating dark and light horizontal lines, more evident below the lateral line.

Radial formula D. I. 11, A. 11-12; scales  $11\frac{1}{2}$ -61- $12\frac{1}{2}$ . Depth  $2-2\frac{1}{8}$ , head  $3\frac{2}{3}$ -4 in the length.

Trocera on Tocantins, one specimen 11 cm. long. The Amazons one specimen 9.5 cm. long. These specimens may be placed as *brama*, although the description given by Günther is so brief I can not be certain concerning them. I have not access to the description of Cuv. & Val. or that of Castelnau.

14. **Prochilodus scrofa** Steindnacher.

Flussfische Sudamerica's, II., 29, pl. VI., fig. 2, 1881. (Rio Janeiro). Eigenm. & Eigenm., Proc. U. S. Nat. Mus., XIV., 48, 1891.

Brazil, one specimen.

15. **Chilodus labyrinthicus** (Kner),

*Microdus labyrinthicus* Kner. Denkschr. Acad. Wiss. Wien., XVII., 1859, 149, taf. 3, fig. 5 (Rio Branco; Rio Negro).

*Cenotropus labyrinthicus* Günther, Cat. Fish. Brit. Mus., V., 297, 1864 (Capin River); Steind., Flussf. Südamerika's, I, 5, 1879 (Orinoco near Ciudad, Bolivar).

*Chilodus labyrinthicus* Eigenm. & Eigenm., Proc. U. S. Nat. Mus. XIV., 49, 1891.

Three specimens from the Fall of Rio Tapajos; one specimen marked Brazil.

16. **Hemiodus microcephalus** Günther.

Cat. Fish. Brit. Mus., V., 298, 1864 (River Capin); Eigenm. & Eigenm. Proc. U. S. Nat. Mus., XIV., 49, 1891.

One specimen from Brazil.

17. **Hemiodus microlepis** Kner.

Denkschr. Wien. Acad., XVII., 155, taf. 4, fig. 8 (Rio Guapore; Rio Negro); Günther, Cat. Fish. Brit. Mus., V., 300, 1864, Eigenm. & Eigenm. Proc. U. S. Nat. Mus. XIV., 49, 1891.

*Emiodus microlepis* Cope, Proc. Amer. Philos. Soc., 86, 1878 (Peruvian Amazon).

Brazil, three specimens. D. 11, A. 13. Head  $4\frac{1}{2}$ ; depth  $3\frac{1}{2}$ - $3\frac{2}{3}$ ; Braret, three specimens 11 cm. long. The proportions are, head  $4\frac{1}{8}$ ; depth 4.

18. **Anostomus vittatus** (Cuv. & Val).

*Piabuca vittata* Cuv. & Val., XXII., 115, 1848; Casteln. Anim. Amer. Sud. Poiss. p. 64, pl. 32, fig. 1, 1855 (Rio Uruguay).

*Anostomus vittatus* Günther, Cat. Fish. Brit. Mus. V., 303, 1864; *id.* Ann. & Mag. Nat. Hist., 12, 1880 (La. Plata); Garman, Bull. Essex Inst., XXII., 19, 1890; Eigenm. & Eigenm., Proc. U. S. Nat. Mus., XIV., 50, 1891.

One specimen from Brazil.

## ANOSTOMATINÆ.

19. **Anostomus fasciatus** Agassiz.

*Curimatus faciatus* Spix., Pisc. Bras. tab. 36, 1829.

*Schizodon fuscatus* Agassiz in Spix., Pisc. Bras. p. 66; Müll. & Trosch., Hor. Ichthyol., III., 10, tab. 1, fig. 5, 5a, 1855 (Brazil, Guiana); Schomb., Fish, Guiana, I., 252, pl. 26, 1841 (Rio Branco); Schomb. Reisen in Brit. Guiana, 634, 1848.

*Anostomus fasciatus* Günther, Cat. Fish. Brit. Mus., V., 304, 1864 (British Guiana; Caraccas); Cope Proc. Acad. Nat. Sci. Phila., 258, 1871 (Ambyiacu); *id.*, Proc. Amer. Phil. Soc., XVII, 689, 1878 (Peruvian Amazon); Steind., Flussfische Südamerica's, IV., 12, 1882 (Huallaga); Garman. Bull. Essex Inst., XXII., 18, 1890; Eigenm. & Eigenm., Proc. U. S. Nat. Mus., XIV., 50, 1891.

*Piabuca schizodon* Cuv. & Val., XXII., 112, 1848.

Braret, two specimens; Brazil, one specimen; D. 12; A. 11; head  $4\frac{1}{2}$ ; depth 4; diameter of eye in snout,  $1\frac{1}{4}$ , the caudal band as in *vittatus*

20. **Anostomus varius** Garman. Bull. Essex Inst., XXII., 19, 1890

Two specimens from Brazil.

The dark bands are all very indistinct. Head 5; depth  $4\frac{2}{3}$  in the length.

21 **Nannostomus eques** Steindachner.

Ichth. Beitr., V., 74-82, 1876, pl. IX.; Eigenm. & Eigenm., Proc. U. S. Nat. Mus., XIV., 49, 1891.

One specimen from the Lower Amazons.

22. **Leporinus frederici** (Bloch).

*Salmo frederici* Bloch, taf. 378, 1885?; Bl. Schn., p. 403, 1861.

*Leporinus frederici* Cuv. & Val., XXII., 25, 1848; Kner, Denkschr. Acad. Wiss. Wien. XVII., 170, 1859 (Rio Branco); Günther, Cat. Fish. Brit. Mus., V., 306, 1864 (Essequibo; Cupai); Eigenm. & Eigenm., Proc. U. S. Nat. Mus., XIV., 51, 1891.

*Curimatus acutidens* Valenciennes in d'Orb Voy. Amer. Merid. Poiss. pl. 8, fig. 1, 1811.

Lower Amazon, four specimens.

**23. *Leporinus conirostris*.**

Steindachner Sitzb. K. K. Akad. Wiss. Wien. LXXI., 23, pl. IV.;  
Eigenm. & Eigenm., Proc. U. S. Nat. Mus., XIV., 51, 1891.

Rio Parahyba, one specimen.

## TETRAGONOPTERINÆ.

***Tetragonopterus* Cuvier.**

*Tetragonopterus* Cuv., Regne Anim., II., 166, 1817(*argenteus*); *id*, Mem. Mus., IV., 455, 1818.

*Tetragonopterus* Swainson, Nat. Hist., II., 289, 1839 (*aureus* and *chalcus*).

*Tetragonopterus* Lütken, Velhas-Flodens Fiske, 206, 1875.

*Tetragonopterus* Eigenm. & Eigenm., Proc. U. S. Nat. Mus., XIV., 52, 1891.

*Pecilurichthys* Gill, Ann. N. Y. Lyceum Nat. Hist., 54, 1858 (*brevoorti*).

*Hemmigrammus* Gill, l. c. (*unilineatus*).

*Astyanax* Girard, U. S. Mex. Bound. Survey, 74, 1859 (*argentatus*).

*Cretochanes* Günther, Cat. Fish. Brit. Mus. V., 318 and 329, 1864 (*melanurus*).

*Hemibrycon* Günther, Cat. Fish. Brit. Mus., V., 318 and 330, 1864 (*polyodon*).

Type: *Tetragonopterus argenteus* Cuvier.

Various species of the genus *Tetragonopterus* have been taken for types of distinct genera. However desirable it would be to divide this large genus into smaller ones, the characters heretofore used to designate the new genera are so variable in different species that they cannot even be considered of subgeneric value. The completeness or incompleteness of the lateral line, which was taken as one of these characters, is found to vary in some of the species. The completeness or incompleteness of the dentition of the maxillary seems not more fortunate as a character for generic division. I am not familiar with *T. melanurus* or any of the other members of this supposed subgenus, and cannot say whether its characters are valid. For the present all of these forms have been united under the generic name *Tetragonopterus*.

The species may be distinguished by the following synopsis:—

**1. Lateral line complete.****a. Anal rays 40 or more.\*****b. Scales in the lateral line 30.**

\* *T. caucanus* has anal rays 38?–41.

- c. *Entire edge of maxillary finely denticulate*, a few conical teeth near its articulation. Body with silvery longitudinal bands. A. 40, the pectorals extend beyond the root of the ventrals. 24. **artedii**.
- cc. Maxillary with only a few rudimentary teeth near its articulation.
- d. *Body with two dark cross-bands*, no longitudinal band. One of the cross-bands extends to the gill opening, the other toward the middle of the pectoral fin, both descending from before the dorsal. A dark caudal spot; depth not less than half the length, head about one-fourth, A. 40.....25. **argenteus**.
- dd. *No dark cross-bands*, ventral and anal fins orange-red. Depth three-fifths, head somewhat more than one-fourth. Eye large, A. 40.....26. **rufipes**.
- bb. Scales in the lateral line 37-40.
- e. A silvery lateral band.
- f. *Maxillary denticulate with minute teeth its entire length*, elongate extending to the middle of the pupil. Humeral spot present, none on the caudal; the silvery lateral band narrow, dorsal rays prolonged. A. 41, scales 4 or 5-40-6. 27. **pectinatus**.
- ff. Maxillary not denticulate its entire length.
- g. *A small tooth on the maxillary*. The round caudal and humeral spot not very distinctly developed. The middle of the caudal fin thickly spotted with dark dots. Head nearly 4, depth about  $2\frac{3}{4}$  in the length. Maxillary does not reach the orbit. A. 40-42, scales 6-37 or 38-4. 28. **tabatingæ**.
- gg. *Several small teeth on the upper fore edge of the maxillary*. Head  $3\frac{3}{5}$ , depth 3 or somewhat more, snout 4 in the head. A silvery-gray lateral band bordered above by blue-green. Humeral spot round. Caudal spot when present extends to the end of some of the caudal rays. 29. **bairdii**.
- ggg. Maxillary toothless.
- h. *Scales 10-41 or 42-9. A small silvery green lateral band*. A dark spot on the basis of the caudal, depth half the length. A. 40-41. 30. **multiradiatus**.
- hh. *Scales 7 or 8-41-6 or 7*, humeral and caudal spot present, the pectorals extend beyond the origin of the ventrals. Maxillary extends somewhat beyond the front margin of the orbit. A. 38?-41; head  $3\frac{1}{4}$ - $3\frac{3}{5}$ ; depth  $2\frac{1}{5}$ - $2\frac{1}{4}$ . 31. **caucanus**.
- ee. *No lateral band*, caudal spot present, no humeral spot, the dorsal fin distinctly behind the ventrals, the pectorals extend considerably beyond the base of the ventrals. Depth about  $2\frac{1}{3}$ ; head  $3\frac{3}{5}$  in the length. A. 44; scales 7-38-7.....32. **nigripinnis**.

bbb. Scales in the lateral line 47.

- i. *No teeth on the maxillary.* A very distinct lateral, silvery band, an indistinct caudal and humeral spot. Maxillary extends to the anterior margin of the orbit. Depth 2.2 in the length, eye 3 in the head, A. 47; scales 9 or 10-47-10 or 11.

33. *hauxwellianus*.

- ii. *Maxillary with a few rudimentary teeth near its articulation.* A silvery lateral band present. Ventral profile much arched, snout pointed, A. 48. .... 34. *spilurus*.

aa. Anal rays 30-39 (*abramis* 28-31; *lacustris* 24-32; *maximus* 29-31; *melanurus* 26-30).

j. Lateral line with 45-47 scales.

- k. *Anal rays 37; scales in 13 rows.* Maxillary toothless, extends to the eye. A black band extends from the base of the caudal fin along its middle rays. Depth somewhat less than  $\frac{1}{3}$  of the body, head  $\frac{1}{4}$ . Diameter of the eye  $\frac{1}{3}$  of the head, a little more than the snout. Last dorsal rays over the anterior anal rays, A. 37; scales 6-46-7. .... 35. *brevirostris*.

kk. Anal rays less than 37.

- l. *Caudal fin black, with two large orange spots, scales in  $11\frac{1}{2}$  rows.* Dorsal over the ventral, the pectoral reaches to the base of the ventral. Depth  $3\frac{1}{2}$ -4; head  $4-4\frac{1}{2}$ . Maxillary toothless, long and narrow, extends to or nearly to the middle of the eye. A. 26-30, scales 7-45 or 46- $4\frac{1}{2}$ . .... 36. *melanurus*.
- ll. *Caudal fin without orange spots, the black spot indistinct or wanting, scales in 18 rows.* An indistinct blackish humeral spot which is sometimes wanting. Dorsal distinctly behind the ventral, the pectoral reaches the ventral. Depth  $2\frac{1}{2}$ , head rather less than 4, A. 28-31, scales 10-43 to 47-8. Maxillary toothless, extends somewhat beyond the anterior edge of the orbit.

37. *abramis*.

jj. Scales in the lateral line 36-43.

m. Humeral and caudal spots present.

n. *Maxillary toothed its entire length.*

Maxillary teeth distinct the maxillary extends nearly or entirely under the middle of the eye. Depth  $2\frac{1}{3}$ -3, head  $4\frac{1}{3}$ - $4\frac{2}{3}$ ; eye in head  $3\frac{1}{4}$ - $3\frac{1}{2}$ . A silvery band connects the caudal and humeral spot. Anal under the middle of the base of the dorsal, which is behind the insertion of the ventrals. D. 10; A. 29-31, scales 8 to 9-39 to 40-6 or  $6\frac{1}{2}$ . .... 38. *jelskii*.

Maxillary teeth very small, the maxillary extending somewhat beyond the front margin of the eye. Depth 2 to  $2\frac{2}{3}$ , head  $4-4\frac{1}{3}$ ; eye in the head 3, in interorbital space  $3-2\frac{1}{3}$ . A black spot behind the shoulder, a black elongate blotch on the caudal peduncle extending to the end of some of the rays, these spots connected by a silvery line. D. 11. A. 32-33. P.

12-14. V. 8, scales 7 to  $8\frac{1}{2}$ -30 to  $37-6\frac{1}{2}$  to  $7\frac{1}{2}$ ...\*39. **maculatus**.  
nn. Maxillary not toothed its entire length.

o. A. single small tooth on the maxillary.

p. *Anal rays 39*, an indistinct silvery lateral band, an oval humeral spot and a caudal spot extending to the end of the rays and fading out on the caudal peduncle. Dorsal over the space between the ventral and anal fins, the pectoral extends beyond the origin of the ventral, A. 39, head 4, depth  $2\frac{2}{3}-2\frac{3}{4}$ ; eye  $2\frac{2}{5}-2\frac{1}{2}$ , snout  $4-4\frac{1}{2}$  in the head.

41. **branickii**.

pp. *Anal rays 34*, a very distinct humeral and caudal spot, the latter often extending to the end of the rays. An obscure silvery band present, A. 34, scales 7-37 to 40-7. Head about  $\frac{2}{3}$  of the length ..... 42. **brevoortii**.

oo. Maxillary without teeth. †

q. *Anal rays 38, scales in 18 rows*. A silvery, lateral band and humeral spot present, the former very distinct. Dorsal fin a little behind the origin of the ventrals, the anterior anal rays elongate. The maxillary extends to near the anterior margin of the eye. Depth 2.4, head 3.5, A. 38, scales 8-39-10 ..... 43. **stilbe**.

qq. *Anal rays fewer than 38, scales in 15 rows*. Maxillary extending to below the centre of the eye. Dorsal originates above the base of the ventrals. Pectorals reach base of ventrals, the ventrals reaching the origin of the anal. Head  $3\frac{3}{4}$ , depth  $2\frac{3}{4}$ . Diameter of eye  $\frac{1}{3}$  of head,  $1\frac{1}{3}$  length of snout, equal to interorbital width. Dorsal I. 10, originating above base of ventrals. Anal II. 28, originating a little behind the vertical of the base of the dorsal. Scales 8-37 to 38-7. Black humeral spot present, a silvery lateral stripe turning to black on the tail, and extending on the caudal. .... 44. **moorii**.

mm. No humeral spot.

r. Caudal spot present.

s. *Maxillary armed with 10 minute teeth*. Dorsal fin behind the ventral, the pectoral reaches the ventral. Depth 3, head 3. A. 32-33, scales 7 or 8-40-7. .... 45. **trinitatis**.

ss. *Maxillary toothless or with only 2 or 3 small teeth*. The elongate caudal band extends to the end of the rays and fades out anteriorly. Head 4, depth  $2\frac{3}{5}$ , eye  $3\frac{2}{3}-4$ , snout 4 in the head. A. 29-31, scales 7 or 8-37 or 38-6. 46. **maximus**.

\**T. maculatus lacustris* (40). Head  $4\frac{1}{4}$ ; depth  $2\frac{1}{3}$ ; A. 24-32; scales 6-34 to 36-6 to 7, eye 3—head.

† Not examined in *stilbe*.



- rr. No caudal spot or lateral band. A. 34, scales  $10\frac{1}{2}$ –43–10. 47. **polylepis**.
- jjj. Lateral line with 33–36 scales.
- t. Depth  $1\frac{1}{2}$  in the length. Caudal and humeral spot generally present and united by a silvery band. Maxillary not denticulate. Head 4, depth  $1\frac{1}{2}$ . A. 34, scales 35.....48. **orbicularis**.
- tt. Depth more than  $1\frac{1}{2}$  in the length.
- u. A blackish longitudinal band above the lateral line becoming darker on the caudal fin. A. 30, scales 6–36–6.....49. **peruvianus**.
- uu. No black longitudinal band.
- v. Maxillary without teeth.
- w. Humeral and caudal spot present, more or less distinct, scales 7–36–7. Anal and ventral with broad red margins. A. 27–31, head 4, depth 3 ..... 50. **humilis**.
- ww. No caudal or humeral spot. A silvery lateral band, most distinct posteriorly. A. 30, scales 5–35–3 $\frac{1}{2}$ , head 3 $\frac{1}{2}$ , depth 3 $\frac{1}{2}$ ; eye in the head 2 $\frac{1}{2}$  and once in the interorbital space. 51. **astictus**.
- vv. Maxillary with teeth.
- x. A single tooth on the maxillary, lateral line with 38 scales. Dorsal fin midway between the tip of snout and caudal, the pectoral reaches the ventral, and the ventral to the anal. A. 32–35, scales 7–38–7, head 4, depth 3..... 52. **tæniurus**.
- xx. Maxillary with numerous teeth, scales 8–35 or 36–7. Dorsal behind the ventral fin. Humeral spot sharply defined, usually vertically elongate. Caudal spot present, a silvery gray lateral band. A. 34–36, head 3 $\frac{3}{4}$ –4, depth 2 $\frac{1}{6}$ –2 $\frac{1}{3}$ ... 53. **doceanus**.
- jjjj. Scales in the lateral line 28–32.
- y. A small blackish caudal spot present.  
Anal 33–34. Scales 7–30 to 32–4 $\frac{1}{2}$ .....54. **chalceus**.
- yy. No Caudal or humeral spot. A. 33.  
Scales in the lateral line 28–29 .....55. **gibbosus**.
- aaa. Anal rays 24–29 (*melanurus* 26–30).
- z. Lateral line with 54–61 scales. Maxillary with a series of teeth on the proximal two-thirds of its length. Caudal deeply forked, the superior lobe larger. Head 5 $\frac{3}{4}$ , depth 3 $\frac{1}{5}$ . A. 29 .....56. **ipanquianus**.
- zz. Scales in the lateral line 45–46.
- A. Longitudinal series of scales 19. Caudal and humeral spot generally absent. Caudal fin not scaly, the origin of the dorsal above the root of the ventral fin. Width of the interorbital more than the diameter of the eye. Head 4, depth 3. A. 26, scales 9–45–10...57. **cordovæ**.
- AA. Longitudinal series of scales less than 19.
- B. A broad silvery lateral stripe, no caudal spot, longitudinal series of scales 12. Maxillary toothless, rather wide, extends little beyond anterior border of the orbit. Head 4.2, depth 4.7. A. 25. 58. **longior**.

BB. No lateral band, caudal fin black with two large orange spots on the basal half. Maxillary toothless, extends to or nearly to the middle of the eye. Dorsal fin over the ventral. Head  $4\frac{1}{3}$ – $4\frac{1}{2}$ , depth  $3\frac{1}{2}$ –4, scales 7–45 or 46– $4\frac{1}{2}$ . A. 26–30. .... 37. **melanurus**.

zzz. Scales in the lateral line 40–43.

C. Maxillary without teeth.\*

D. Maxillary long and narrow, extends to the middle of the eye. Caudal fin black or blackish, with a pair of large, red spots on its basal half. Dorsal fin somewhat behind the ventral. Head  $4\frac{1}{3}$ , depth  $3\frac{1}{4}$ . A. 27, scales 7–43– $4\frac{1}{2}$ . .... 59. **affinis**.

DD. Maxillary not extending to the middle of the eye. Dorsal over the ventral. Caudal blackish with two red spots on its basal half. A. 26, scales  $6\frac{1}{2}$ –42–4. .... 60. **caudomaculatus**.

CC. Maxillary with evident teeth its entire length.

E. Humeral spot and lateral band present, caudal spot generally absent. Head  $4\frac{1}{3}$ , depth  $2\frac{2}{3}$ –3. A. 26, scales  $7\frac{1}{2}$  or 8–42 to 44–6 or 7. .... 61. **huambonicus**.

EE. No humeral spot present or lateral band, middle caudal rays black. Origin of the dorsal fin midway between the tip of the snout and root of the caudal, behind the ventral and over the anterior anal rays. A. 27. Head  $4\frac{1}{2}$ , depth  $3\frac{1}{2}$ , scales 8–45–6.

63. **polyodon**.

zzzz. Scales in the lateral line 34–39.†

F. Lateral band, humeral and caudal spot present.

G. Lateral band black, scales in 13 rows. Dorsal fin behind the base of the ventrals. Maxillary toothless, extends a little behind the anterior border of the orbit. Interorbital space much more than the diameter of the eye. Head  $3\frac{2}{3}$ , depth 3. A. 28, scales 7–34–6.

64. **wappi**.

GG. No black lateral band.

H. Caudal fin with a band on one or both lobes.

I. Upper caudal lobe with a black band, head 4 in the length. A silvery lateral band, pectorals do not extend to the base of the ventrals. Dorsal fin nearly over the ventrals. Maxillary extends to the eye. Head 4, depth nearly 3. A. 24–25, scales 5 or  $5\frac{1}{2}$ –36– $3\frac{1}{2}$  or 4. .... 65. **lepidurus**.

II. Each caudal lobe with a black cross-band, head 5 in the length.

A silvery lateral band. Dorsal over the hinder ventral rays. The maxillary does not extend beyond the anterior border of the orbit. Depth  $2\frac{2}{3}$ . A. 25–26, scales 5–36 to 38–3 or 4.

68. **dichrourus**.

\* *T. taeniatus* Jen. (62) has scales 7–40–6. D. 11, A. 25. Depth 3, humeral and caudal spots present, united by a silvery band.

† D. 10, A. 27, scales 5–37–3. .... *alburnus* 66.

A. 29, scales  $8\frac{1}{2}$ –38–8. .... *gronovii* 67.

HH. Caudal fin without bands.\*

J. *Anal, dorsal and caudal fins with red markings, scales in  $9\frac{1}{2}$  rows.*

The blackish humeral and caudal spots indistinct. The triangular vermilion spot on the caudal surrounds the basal black spot. Head 4.2, depth 3.3. A. 26-27, scales  $5\frac{1}{2}$ -35-4.

69. *phœnicopterus*.

JJ. No red markings on the fins.

K. Scales in 15 rows.

L. A broad silvery band, head 4, depth 2, scales 7-37-8.

A. 29. The dorsal a short distance behind the origin of the ventral. Maxillary reaches a little beyond the orbit.

70. *orientalis*.

LL. Head  $3\frac{3}{4}$ , depth  $2\frac{2}{3}$ - $2\frac{3}{4}$ , maxillary reaches the anterior of the eye. A. 28, scales 8-35 or 36-7.

71. *panamensis*.

KK. Scales in less than 15 rows.

M. *Head less than 4 in the length. Maxillary extends beyond the anterior border of the orbit. Head  $3\frac{1}{2}$ , depth 3.*

A. 25, scales 6-37 or 28-5.....73. *scabripinnis*.

MM. Head 4, or more than 4 in the length.

N. *A band-like caudal spot, sometimes extending forward to the indistinct humeral spot. Maxillary toothless, extends distinctly beyond the anterior margin of the eye. Origin of dorsal fin immediately behind the base of the ventrals. Head  $4-4\frac{1}{2}$ , depth  $2\frac{3}{5}$ - $2\frac{2}{3}$ , A. 25-29, scales 6 to 7, 30 to 39,  $4\frac{1}{2}$  to 6.....†74. *rutilus*.*

NN. *No band-like caudal spot, a silvery lateral band. Maxillary toothless, extends beyond the anterior border of the eye. Snout rather compressed. Head 4, depth 3. A. 27, scales 7-37-7.....76. *petenensis*.*

FF. A silvery lateral band, and band-like blackish caudal spot. Head  $4-4\frac{1}{5}$ , depth  $2\frac{3}{4}$ , interorbital much more than diameter of the eye. Maxillary terminates below the front margin of the eye. Origin of dorsal fin behind the root of the ventrals. Scales 7-35 to 37-8.

77. *microphthalmus*.

FFF. No distinct lateral band present in adult specimens.

O. Humeral and caudal spot present, the latter sometimes extending to the end of some of the rays. Humeral spot vertically elongate, situated in the centre of a pale area which is bounded posteriorly by a vertically curved border. Head 4, depth  $2\frac{1}{4}$ , scales 6 to 8-36- $6\frac{1}{2}$ . A. 27-28.....98. *jacuhiensis*.

OO. Humeral or caudal spot absent.

P. *No humeral spot, caudal spot present, depth more than twice in the*

*T. carolinæ* Gill (72) is perhaps related to *T. phœnicopterus* Cope.

†*T. rutilus jequitinhonhæ* (75) has scales 38. A. 26, head  $4\frac{1}{8}$ , depth 3

length. No lateral band. The origin of the dorsal fin behind the base of the ventrals. Maxillary toothless, reaches anterior border of the orbit. Head 4, depth  $2\frac{1}{4}$ - $2\frac{3}{4}$ . A. 26, scales 7-35-6.

78. *æneus*.

PP. Humeral spot present, no caudal spot, depth a little less than twice in the length. Maxillary extends to the eye. Dorsal fin over the middle of the base of the ventral. Head 4, scales 7-34-7. A. 28.

79. *chrysargyreus*.

zzzzz. Scales in the lateral line 28-33.

Q. A series of seven deep-brown longitudinal lateral bands. Maxillary extends not evidently beyond the front margin of the eye. Head  $3\frac{2}{3}$ , depth a little more than two in length. A. 27, scales 5-31-4.

80. *lineatus*.

QQ. No series of longitudinal bands on the sides.

R. A silvery lateral band.

S. No caudal or humeral spot. The pectoral reaches the ventral. The dorsal over the base of the ventral. Head  $3\frac{2}{3}$ , depth  $2\frac{1}{6}$ . A. 28, scales 5-30 to 33-5.....81. *grandisquamis*.

SS. Humeral spot present, generally more or less elongate. No caudal spot.

T. Maxillary with numerous minute teeth, extends beyond the front edge of the orbit. Snout shorter than the eye. Dorsal fin over the root of the ventral. A. 29-30, scales 5 or 6-32 or  $33-4\frac{1}{2}$  or 5. Head  $3\frac{2}{3}$ , depth  $2\frac{1}{4}$ - $2\frac{1}{2}$ .....82. *bahiensis*.

TT. Maxillary without teeth.

U. The narrow silvery band edged above with greenish, humeral spot indistinct. Origin of the dorsal fin just behind the ventral. The pectoral reaches to the middle of the base of the ventral. Head  $3\frac{2}{5}$ - $3\frac{3}{4}$ , depth  $2\frac{1}{5}$ - $2\frac{2}{7}$ . A. 24-25, scales 5-32 or  $33-3\frac{1}{2}$ .....83. *collettii*.

UU. Silvery band not edged above with greenish, humeral spot large, faded. Maxillary reaches nearly to the middle of the eye. Dorsal fin over the base of the ventral.

84. *xinguensis*.

SSS. Humeral and caudal spot present, the entire anterior third of the caudal dark colored. Maxillary toothless. Head  $3\frac{2}{3}$ , depth  $2\frac{1}{7}$ . A. 26-27, scales 5-28-4.....85. *agassizii*.

RR. No silvery lateral band.

V. Scales  $5\frac{1}{2}$ -31-6. A. 26. Depth 2. Caudal spot diffuse extending over the base of the fin. Humeral spot indistinct. Maxillary extends somewhat beyond the anterior margin of the eye. Origin of the dorsal fin immediately behind the root of the ventral. The pectorals extend beyond the ventrals, the ventrals to the vent. Diameter of the eye more than the width of the interorbital, less than the snout, one-third of the head. Head  $3\frac{2}{3}$ .

86. *ovalis*.

VV. Scales 5-28-3½, depth 2½. A. 24. Humeral and caudal spot present. Origin of the dorsal fin behind the ventral. The maxillary extends to the front margin of the eye. Head 4.

87. *oligolepis*.

aaaa. Anal rays 16-24.\*

W. Scales in the lateral line 38-40. A silvery-gray lateral band present, a dark caudal spot elongate horizontally, fading out forward. No humeral spot present. Dorsal behind the ventral. Maxillary with two small serrated teeth. Head 4, depth 2¾-2⅞. A. 21-23, scales 7 or 8-37 or 38-8. ....†89. *mexicanus*.

WW. Scales in the lateral line 30-35.

X. Maxillary without teeth.

Y. Caudal and humeral spot generally absent.

Z. A silvery band present, sharply edged above with a dark band. Head less than 4 in the length. Maxillary toothless. Dorsal fin a little behind the ventrals. The pectorals do not entirely reach the ventrals, the ventrals reach the anal. Head 3½, depth 3-3½, scales 5-32-3 or 3½. A. 21-22. ....91. *copei*.

ZZ. The broad silvery band not edged above with dark, head more than 4 in the body. Maxillary toothless extending nearly to the anterior border of the orbit. Anterior dorsal and anal rays markedly elongate. A. 19, head 4½, depth 3½, scales 4-35-3½.

92. *diaphanus*.

YY. Caudal and humeral spot present, the dark humeral spot surrounded by a light-colored band. Maxillary extends to the pupil of the eye. Snout short, 4 in the head. Dorsal fin just behind the ventrals, pectorals reach a little beyond the origin of the ventrals, the ventral somewhat beyond the front margin of the anal. A. 20-22. Head 3½, depth 3½, scales 5-30-3. ....93. *santaremensis*.

XX. Maxillary with teeth.

a. Numerous minute teeth on the maxillary which extends either a little or distinctly behind the front margin of the orbit. A vertically elongate humeral spot, and a longitudinal caudal stripe extending to the end of the rays and fading out anteriorly. A. 15-16, head 3¼-3¾, depth 3-3½, scales 5 or 5½-33-4 or 4½. ....94. *jenynsii*.

aa. Maxillary with only 1-3 teeth, extends to the anterior border of the pupil of the eye. A silvery lateral band present, and a diffuse caudal spot, no humeral spot. A. 19, head 3½, depth 2¾, scales 5-31-3. ....95. *paucidens*.

## II. Lateral line interrupted or complete.

\* Anal rays 19-24.

† Scales of moderate size 5 or 6-35 to 38-6 or 7. Maxillary with 1 to 3 teeth. A dark caudal spot extends to the end of some of the rays and

\* *T. pulcher* (88) A. 22, D. 10, Head 5¼, depth 3⅔ (with caudal). Eye 3 in the head and once in the interorbital. Caudal and humeral spot present.

† *T. argentatus* (90) is very near and may be identical with *mexicanus* Filippi.

fades out anteriorly, being replaced by a silvery band. An indistinct humeral spot present. Ventral and pectoral fins with red. Head 4, longer than deep at the occiput, depth  $2\frac{1}{2}$  to 3. ....\*96. **fasciatus**.

†† Scales conspicuously larger, anal shorter than in *fasciatus*. The humeral and caudal spots much less distinct. Head  $4-4\frac{1}{3}$ , depth  $2\frac{1}{2}-3$ , D. 10, A. 3, 16-19, scales 5 to  $5\frac{1}{2}-35$  to 37-3 to 4. ....99. **iheringii**.

\*\* Anal rays 29 to 31, scales 7 or 8-37 to 38-8; eye 3 in the head. Depth 3, head 4 in length. An indistinct lateral band present. ....100. **orstedii**.

**III.** Lateral line not complete ; only some of the anterior scales perforated.

β. Anal rays 15-27.

γ. Scales in the lateral line 30-35.

δ. Dark markings on some of the anal rays.

ε. A large black spot on the upper part of the dorsal, no caudal or humeral spot, golden blotches on the opercle. A narrow band of black obliquely crosses four or five of the anterior rays of the anal, commencing at the top of the first ray. Lateral line extends to the middle of the body. Head  $4\frac{1}{3}$ , depth  $3\frac{1}{3}$ , eye  $3\frac{2}{7}$  in the head, scales in 12 rows. A. 27. ....101. **unilineatus**.

εε. No conspicuous black spot on the dorsal. A faint dark lateral band, a milk-white stripe on the fore edge of the anal, and a violet stripe immediately behind it. A. 24, head  $3\frac{1}{4}-3\frac{2}{5}$ , depth  $2\frac{2}{5}-2\frac{3}{5}$ , scales 5 or  $5\frac{1}{2}-30$  or 31-4. ....102. **elegans**.

δδ. No dark markings on the anal rays.

ζ. Caudal or humeral spot present.

η. Caudal spot present, no humeral spot.

θ. Anal rays 21-24, 6-12 scales in the lateral line perforated, the caudal spot does not extend to the end of the rays, but extends forward as a dark band, becoming less distinct anteriorly. A more or less conspicuous silvery lateral band present. Caudal deeply lobed. Dorsal behind the ventrals, the pectorals extend to the ventrals. A. 21-24, head  $4\frac{1}{4}$ , depth 4, scales 5-32 or 33-4. ....103. **gracilis**.

θθ. A. 17-19, perforated scales in the lateral line 4-7, the large, diffuse, dark caudal spot extends to the end of some of the rays and fades out anteriorly. No humeral spot. An inconspicuous silvery lateral band present. Pectoral almost touches the ventral. Caudal deeply lobed. Size small, depth 4 in the length. Scales 4-30 or 32-? ....104. **nanus**.

ζζ. No caudal spot, the humeral spot surrounded by a bright ring, round or oval, when oval vertically elongate. A sharply marked blue-gray line extends backward to the base of the caudal fin. Dorsal behind the ventral, the pectoral extends to its base. The ventral

\* *T. fasciatus interrupta* (97), 11 scales across the back, in front of the dorsal between the lateral line and lateral line. Scales 32-35, A. 22-24. Eye slightly less than the inter-orbital.

extends to the origin of the anal. Diameter of the eye  $2-2\frac{1}{3}$ , snout 4 in the head. Lateral line with 5-7 scales perforated. A. 22-24, head  $3\frac{1}{2}-3\frac{3}{4}$ , depth  $3\frac{1}{3}, -3\frac{2}{5}$  scales 5-31 or 32-3.

105. *bellottii*.

§§§. Caudal and humeral spot present, the latter indistinct in *schmardæ*, where the caudal spot is conspicuous and extends to the end of some of the rays.

i. *Maxillary without teeth*. Indistinct humeral spot small; a small silvery-gray lateral band, not very evident, accompanied above a part of its length by a sharp, blue-gray line. Pectorals not quite reaching the ventrals. Diameter of the eye 2, snout  $3\frac{1}{2}$  in the head. Lateral line with 7-8 more rarely 13-16 scales perforated. A. 20-23, head  $3\frac{2}{3}$ , depth 3, scales 5-30 or 31-3.....106. *schmardæ*.

ii. *Maxillary with teeth*.

κ. *Humeral spot surrounded by a bright ring*. Maxillary with slender teeth. Caudal spot deep dark brown. A sharp gray line joins the humeral and caudal spot. Caudal partly scaled, the peduncle very slender. The dorsal fin behind the origin of the ventrals, 6-8 scales in the lateral line perforated. A. 26-28, head  $3\frac{1}{3}-3\frac{3}{4}$ , depth  $2\frac{2}{5}-2\frac{3}{4}$ , scales 5-31- $3\frac{1}{2}$ .....107. *ocellifer*.

κκ. *Humeral spot not surrounded by a bright silvery-gray border*. *Maxillary with 5 small, stout teeth*. A greenish lateral band, the humeral and caudal spot indistinct. Middle of caudal fin blackish. Body brown, muzzle black, cheeks black punctate. Maxillary extends to the middle of the pupil. Dorsal behind the ventrals. A. 27, head  $3\frac{1}{2}$ , depth  $2\frac{1}{4}$ , eye  $\frac{1}{3}$  of the head, scales 7-30-6.....108. *robustus*.

§§§§. *No caudal or true humeral spot*, the anterior end of the very conspicuous dark lateral band with an oval expansion resembling a humeral spot. The dark band bordered above by a very evident silvery band. Dorsal about midway between the tip of the snout and base of caudal and over the space between the anal and ventrals. Anal with first six rays elongate. Maxillary toothless, extends nearly to the centre of the pupil of the eye. D. 10, A. 20-23, head  $3\frac{1}{2}$ , depth  $3\frac{1}{2}$ , eye in the head  $2\frac{1}{2}$  and once in the interorbital, scales 32-34.....109. *heterorhabdus*.

## 24. *Tetragonopterus artedii* Cuv. & Val.

Cuv. & Val. XXII., 128 (not Synon. *vide* Günther); Günther, Cat. Fish. Brit. Mus., V., 319; Eigenm. & Eigenm., Proc. U. S. Nat. Mus., XIV., 52, 1891.

*Habitat* :—?

**25. *Tetragonopterus argenteus* Cuvier.**

Cuv. Mem. Mus., IV., 455 ; Cuv. & Val., XXII., 132 ; Müll & Trosch., Fish. Brit. Guiana, 634, 1848 (Amuca) ; Kner, Denkschr. Acad. Wiss. Wien, XVII., 174, 1858 (Cujaba ; Gujana) ; Günther, Cat. Fish. Brit. Mus., V., 318, 1864 ; Steind., Ichthyol., Beitr., V., 46, 1876 (Santarem) ; *id.* Flussfische, Südamerika's, I., 7, 1879 (Orinoco near Ciudad Bolivar) ; *id.* Flussfische, Südamerika's, IV., 13, 1882 (Rio Amazonas ; Iquitos) ; Eigenm. & Eigenm., Proc. U. S. Nat. Mus., XIV., 52, 1891.

*Habitat* :—Orinoco, Guianas, Amazon.

**26. *Tetragonopterus rufipes* Valenciennes.**

Valenc. in d'Oerb. Voy. Amér. Merid. Poss. pl. 11., fig. 1, 1847 ; Cuv. and Val., XXII., 136 ; Günther, Cat. Fish. Brit. Mus., V. 318 ; Eigenm. & Eigenm., Proc. U. S. Nat. Mus., XIV. 52, 1881.

*Habitat* :—Buenos Ayres.

**27. *Tetragonopterus pectinatus* Cope.**

Proc. Amer. Philos. Soc., 560, 1870 (Pebas) ; Eigenm. & Eigenm., Proc. U. S. Nat. Mus., XIV., 54, 1891.

*Habitat* :—Pebas.

**28. *Tetragonopterus tabatingæ* Steindachner.**

Ichthyol. Beitr. ; V. 43, 1876 (Tabatinga) ; Eigenm. & Eigenm., Proc. U. S. Nat. Mus., XIV., 54, 1891.

*Habitat* :—Tabatinga.

**29. *Tetragonopterus bairdii* Steindachner.**

"Anz. Ak. Wien, 179, 1882 (Tabatinga) ;" *id.* Flussfische Südamerika's, IV., 35, 1882 (Tabatinga) ; Eigenm. & Eigenm., Proc. U. S. Nat. Mus., XIV., 53, 1891.

*Habitat* :—Tabatinga.

**30. *Tetragonopterus multiradiatus* Steindachner.**

Ichthyol. Beitr., V. 44, 1876 (Teffe) ; Eigenm. & Eigenm., Proc. U. S. Nat. Mus., XIV., 54, 1891.

*Habitat* :—Teffe.

**31. *Tetragonopterus caucanus* Steindachner.**

Ichthyol. Beitr., VIII., 71, 1878 (Cauca) ; *id.* Fischf. Cauca and Flüsse, 20, pl. VI., fig. 2, 1880 (Cauca) ; Eigenm. & Eigenm., XIV., 53, 1891.

*Habitat* :—Cauca.

**32. *Tetragonopterus nigripinnis* Perugia.**

Ann. Mus. Genov. (2), 643, 1891 (Matto Grosso, River Paraguay).  
*Tetragonopterus anomalus* Steind., Anz. AK. Wien, 1891 and SB. AK. Wien, c. 1891, 173 and 369, pl. III. (Rio Parana).

*Habitat* :—Rio Paraguay ; Rio Parana.



**33. *Tetragonopterus hauxwellianus* Cope.**

Proc. Amer. Philos. Soc., 560, 1870 (Pebas); *id.* Proc. Amer. Philos. Soc., 691, 1878 (Peruvian Amazon); Steindl., Flussfische Südamerikas, IV., 34, 1882 (Hyavary; Santarem); Eigenm. & Eigenm., Proc. U. S. Nat. Mus., XIV., 53, 1891.

*Habitat*:—Peruvian Amazon; Pebas; Hyavary; Santarem.

**34. *Tetragonopterus spilurus* Cuv. & Val.**

Cuv. & Val., XXII., 156; Günther, Cat. fish. Brit. Mus., V., 318, 1864; Eigenm. & Eigenm., Proc. U. S. Nat. Mus., XIV., 52, 1891.

*Habitat*:—Surinam.

**35. *Tetragonopterus brevirostris* (Günther).**

*Tetragonopterus chalceus brevirostris* Günther, Proc. Zool. Soc., 420, 1859. *Brevirostris* Günther, Cat. Fish. Brit. Mus., V., 321, 1864 (Western Andes of Ecuador); Eigenm. & Eigenm., Proc. U. S. Nat. Mus., XIV., 52, 1891.

*Habitat*:—Western Andes of Ecuador.

**36. *Tetragonopterus melanurus* Bloch.**

*Salmo melanurus* Bloch tab. 381, fig. 2.

*Tetragonopterus melanurus* Müll. & Trosch., Hor. Ichth., I., p. 14, 1845 (Surinam); Cuv. & Val., XXII., p. 155, 1848; Müll. and Trosch., Fische Brit. Guiana, 635, 1848 (Rupununi); Günther Cat. Fish. Brit. Mus., V., 329, 1864 (British Guiana; Essequibo River); *id.* Proc. Zool. Soc., 247, 1868 (Surinam).

*Habitat*:—British Guiana; Surinam; Essequibo; Rupununi.

**37. *Tetragonopterus abramis* Jenyns.**

Zool. Beagle, Fish., p. 123, tab. 23, fig. 1, 1842 (Rio Parana); Günther, Cat. Fish. Brit. Mus., V., 321, 1864; Steindl., Flussfische, Südamerika's, I., 8, 1879 (Orinoco near Ciudad Bolivar); Günther, Ann. & Mag. Nat. Hist., 1880 (La Plata); Eigenm. & Eigenm., Proc. U. S. Nat. Mus., XIV., 52, 1891.

*Habitat*:—La Plata; Rio Parana; Orinoco.

**38. *Tetragonopterus jelskii* Steindachner.**

Ichthyol. Beitr., IV., 40, 1875 (Monterico, Peru); *id.* Flussfische, Südamerika's, IV., 25, 1882 (Huambo); Eigenm. & Eigenm., Proc. U. S. Nat. Mus., XIV., 53, 1891.

*Habitat*:—Monterico, Peru; Huambo.

**39. *Tetragonopterus maculatus* (Linnæus).**

*Charax* no. 54, Gronov. Mus. Ichth., I., p. 19, tab. 1, fig. 5, 1754.

*Albula maculata* L. Mus. Ad. Fred. p. 78, tab. 32, fig. 2, 1754.

*Salmo bimaculatus* L., Syst. Nat., ed. xii., 513, 1766 (South America); Bloch, taf. 382, fig., 2, 1758; Bl. & Schn., p. 413, 1801.

*Tetragonopterus maculatus*, Müll. & Trosch., Hor. Ichth., I., p. 14, tab. 3, fig. 4 (teeth); *id.* Fische. Brit. Guiana, 634, 1849 (Rupununi; Essequibo); Gün-

ther, Cat. Fish. Brit. Mus., V., 321, 1864 (Demarara, River Capin; Pernambuco); Steind., Süßwf. Südöstl. Bras., III., 568, pl. I., fig. 2, 1876, (Rio Parahyba; Rio Doci; Rio Mucuri); Peters, Mb. Ak. Wiss. Berlin, 472, 1877 (Cala-bozo); Steind., Fisch.-f. Magd. Stromes, 42, 1878 (Rio Magdalena); *id.* Fisch.-f. Cauca & Flüsse bei Guayaquil, 21, 1880 (Cauca); Boulenger, Ann. & Mag. Nat. Hist., XIX., 173, 1887 (Rio Grande do Sul); Eigenm. & Eigenm., Proc. U. S. Nat. Mus., XIV., 52, 1891.

*Tetragonopterus linnæi* Cuv. & Val., XXII., p. 142.

*Tetragonopterus gronovii* Cuv. & Val., XXII., p. 143; Kner, Denkschr. Acad. Wiss. Wien, XVII., 175, 175, 1859.

*Charax bimaculatus* Gronov. Syst. ed. Gray; p. 154, 1854.

*Tetragonopterus vittatus* Castelnau, Anim. Amer. Sud., Poiss. p. 66, pl. 33, fig. 3. 1755 (Bahia).

*Tetragonopterus microstoma*, Hensel, Wieg. Archiv., 83, 1868 (S. Brazil).

*Tetragonopterus obscurus* Hensel, Wieg. Archiv., 86, 1868 (S. Brazil).

*Habitat*:—Brazil, Orinoco, Magdalena.

Seven specimens from the lower Amazons. Color very light, perhaps faded. Six specimens from Para; Brazil, four specimens.

#### 40. ***Tetragonopterus maculatus lacustris*** Lütken.

*Tetragonopterus lacustris* Lütken, Overs. Dan. Selsk, M. 3, 131, 1874 (Lagoa Santa); *id.* Velhas-Flodens Fiske, XIII., 208, pl. V., fig. 15, 1875, Rio das Velhas; Eigenm. & Eigenm., Proc. U. S. Nat. Mus., XIV., 52, 1891.

*Tetragonopterus maculatus lacustris* Eigenm., Ann. N. Y. Acad. Sci., 1894 (Rio Grande do Sul).

*Tetragonopterus maculatus* Boul.; Ann. Mag. Nat. Hist., 1887 (Rio Grande do Sul).

*Habitat*:—Rio das Velhas; Rio Grande do Sul.

#### 41. ***Tetragonopterus branickii*** Steindachner.

Flussfische Südamerica's, I., 21, 1879, pl. I., fig. 3 (Rio Zurumilla on the boundary of Ecuador and Peru); Eigenm. & Eigenm., Proc. U. S. Nat. Mus., XIV., 53, 1891.

*Habitat*:—Rio Zurumilla.

#### 42. ***Tetragonopterus brevoortii*** (Gill).

*Pœcilurighthys brevoortii* Gill, Fresh Water Fishes Trinidad, 57, 1858 (Trinidad).

*Tetragonopterus brevoortii* Lütken, Vidensk. Medd. Nat. For. Kjöb., 232, 1874; Eigenm. & Eigenm., Proc. U. S. Nat. Mus., XIV., 53, 1891.

*Habitat*:—Trinidad.

#### 43. ***Tetragonopterus stilbe*** Cope.

Proc. Amer. Philos. Soc., 559, 1870 (Para); Eigenm. & Eigenm., Proc. U. S. Nat. Mus., XIV., 54, 1891.

*Habitat*:—Para.

44. **Tetragonopterus moorii** Boulenger.

Ann. N. H. (6) X., II., pl. II., fig. 1 (Matto Grosso, Brazil).

*Habitat*:—Matto Grosso, Brazil.

45. **Tetragonopterus trinitatis** Lütken.

*Tetragonopterus (Hemibrycon) trinitatus* Lütken, Vidensk. Medd. Nat. For. Kjöb., 234, 1874 (Trinidad).

*Habitat*:—Trinidad.

46. **Tetragonopterus maximus** Steindachner.

Ichthyol. Beitr., VI., 6, 1878 (syn.); *id.* Ichthyol. Beitr., IV., 43, 1875, pl. VII. (Tullumayo; Monterico); Eigenm. & Eigenm., Proc. U. S. Nat. Mus., XIV., 54, 1891. *Tetragonopterus alosa* Günther, Ann. & Mag. Nat. Hist., XVII., 399, 1876 (Monterico, Peru).

*Habitat*:—Tullumayo; Monterico.

47. **Tetragonopterus polylepsis** Günther.

Cat. Fish. Brit. Mus., V., 320, 1864; Eigenm. & Eigenm., Proc. U. S. Nat. Mus., XIV., 52, 1891.

*Habitat*:—British Guiana.

48. **Tetragonopterus orbicularis** Cuv. & Val.

Cuv. & Val., XXII., 138; Casteln. Anim. Amer. Sud. Poiss. p. 65, pl. 32, fig. 3, 1885 (Amazon); Kner. Denkschr. Acad. Wiss. Wien, 38, 1858 (Villa Maria); Günther, Cat. Fish., Brit. Mus., V., 320, 1864; Steindachner, Süßwf. Südöstl. Bras., III., 565, 1876 (Rio Parahyba, Amazon; Villa Maria); Günther, Ann. & Mag. Nat. Hist. 1880 (La Plata); Eigenm. & Eigenm., Proc. U. S. Nat. Mus., XIV., 52, 1891.

*Tetragonopterus compressus* Günther, Cat. Fish., Brit. Mus., V., 319, 1864 (Essequibo; Surinam; Marañon).

*Habitat*:—La Plata; Rio Parahyba; Amazon; Marañon; Surinam; Essequibo; Villa Maria.

49. **Tetragonopterus peruanus** Müller & Troschell.

*Tetragonopterus peruanus* Müll. & Trosch., Hor. Ichth., I., 28, tab. 8, fig. 1, 1845 (Peru); Cuv. & Val., XXII., 159.

*Tetragonopterus peruvianus* Günther, Cat. Fish. Brit. Mus., V., 327, 1864; Steind., Flussfische, Südamerika's, I., ü 22, 1879 (Pascamajo, Peru); Eigenm. & Eigenm., Proc. U. S. Nat. Mus., XIV., 53, 1891.

*Habitat*:—Peru.

50. **Tetragonopterus humilis** Günther.

Cat. Fish. Brit. Mus., V., 327, 1864 (Gautemala).

*Habitat*:—Gautemala.

51. **Tetragonopterus astictus** sp. nov.

Related to *humilis*.

Body compressed, moderately elongate. Dorsal fin a little behind the ventral and its anterior edge equidistant from the snout and base of caudal. Maxillary toothless, extending a little beyond the anterior margin of the orbit. A silvery lateral band, most distinct posteriorly. No caudal or humeral spot present.

D. 10, A. 30, scales 5-35-3 $\frac{1}{2}$ , head 3 $\frac{1}{2}$ , depth 3 $\frac{1}{2}$ , eye in the head 2 $\frac{1}{2}$  and once in the interorbital space. Lateral line complete.

*Habitat*:—Brazil (one specimen 53 mm. long).

**52. *Tetragonopterus tæniurus* (Gill).**

*Pæciliurichthys tæniurus* Gill; Fresh Water Fishes, Trinidad, 58, 1858.

*Tetragonopterus tæniurus* Lütken, Vidensk. Medd. Nat. For. Kjöb., 233, 1874; Eigenm. & Eigenm., Proc. U. S. Nat. Mus., XIV., 53, 1891.

*Habitat*:—Trinidad.

**53. *Tetragonopterus doceanus* Steindachner.**

Süsswf. Südöstl. Bras. III., 14, 1876 (Rio Doce); Eigenm. & Eigenm., Proc. U. S. Nat. Mus., XIV., 52, 1891.

*Habitat*:—Rio Doce.

**54. *Tetragonopterus chalcus* Agassiz.**

*Tetragonopterus argenteus* etc., Artedi, in Seba, III., tab. 34, fig. 3; 174, 1858 (Rio Negro, Surinam).

*Daregonus amboinensis* Artedi, Species p. 44, 1738.

*Tetragonopterus chalcus* Agassiz in Spix, Pisc. Bras. p. 70, tab. 33, fig. 1, 1829; Cuv. & Val., XXII., p. 140; Kner, Denkschr. Acad. Wiss., Wien, XVII.; Günther, Cat. Fish. Brit. Mus., V., 320, 1864 (British Guiana; Esse-qui-bo); Cope, Proc. Acad. Nat. Sci., Phila., 260, 1871 (Ambyiacu); *id.*, Proc. Amer. Philos. Soc., 691, 1878 (Peruvian Amazon); Steind., Ichthyol. Beitr., V., 47, 1876 (Xingu near Porto do Moz); Eigenm. & Eigenm., Proc. U. S. Nat. Mus., XIV., 52, 1891.

*Tetragonopterus schomburgkii* Cuv. & Val., XXII., p. 137.

*Habitat*:—British Guiana, Essequi-bo, Surinam, Amazons from Porto do Moz to the Ambyiacu.

**55. *Tetragonopterus gibbosus* Steindachner.**

Süsswf. Südöstl. Bras., III., 4, pl. I, fig. 1, 1876 (Rio Parahyba); Eigenm. & Eigenm., Proc. U. S. Nat. Mus., XIV., 52, 1891.

*Habitat*:—Rio Parahyba.

**56. *Tetragonopterus ipanquianus* Cope.**

Proc. Am. Philos. Soc., XVII., 1877 (Urubamba), *id.* Proc. Am. Philos. Soc., 692, 1878 (Peruvian Amazon); Eigenm. & Eigenm., Proc. U. S. Nat. Mus., XIV., 53, 1891.

*Habitat*:—Urubamba; Peruvian Amazon

57. **Tetragonopterus cordovæ** Günther.

Ann. & Mag. Nat. Hist., VI., Ser. 5, 12, 1880 (Rio de Cordova); Eigenm. & Eigenm., Proc. U. S. Nat. Mus., XIV, 53, 1891.

*Habitat*:—Rio de Cordova.

58. **Tetragonopterus longior** Cope.

Proc. Amer. Philos. Soc., 691, 1878 (Peruvian Amazon); Eigenm. & Eigenm., Proc. U. S. Nat. Mus., XIV., 53, 1891.

*Habitat*:—Peruvian Amazon.

59. **Tetragonopterus affinis** Günther.

Cat. Fish. Brit. Mus., V., 322, 1864 (British Guiana).

*Habitat*:—British Guiana.

60. **Tetragonopterus caudomaculatus** Günther.

Cat. Fish. Brit. Mus., V., 330, 1864 (South America).

*Habitat*:—South America.

61. **Tetragonopterus huambonicus** Steindachner.

Flussfische Südamerika's, IV., 25, pl. V., fig. 1, 1882 (Callacate and Rio Huambo, Peru); Eigenm. & Eigenm., Proc. U. S. Nat. Mus., XIV., 53, 1891.

*Habitat*:—Callacato and Rio Huambo, Peru.

62. **Tetragonopterus tæniatus** Jenyns.

Zool. Beagle, Fish. p. 126; Cuv. & Val., XXII., p. 145; Günther, Cat. Fish. Brit. Mus., V., 329, 1864.

*Habitat*:—Province of Rio de Janeiro.

63. **Tetragonopterus polyodon** Günther.

Cat. Fish. Brit. Mus., V., 330, 1864 (Guayaquil); Cope, Proc. Amer. Philos. Soc., 45, 1877 (Guayaquil); Eigenm. & Eigenm., Proc. U. S. Nat. Mus., XIV., 53, 1891.

*Habitat*:—Guayaquil.

64. **Tetragonopterus wappi** Cuv. & Val.

Cuv. & Val., XXII., p. 153; Günther, Cat. Fish. Brit. Mus., V., 326, 1864 (British Guiana); Eigenm. & Eigenm., Proc. U. S. Nat. Mus., XIV., 53, 1891.

*Habitat*:—British Guiana.

65. **Tetragonopterus lepidurus** Kner.

Denkschr., Wiss. Wien., XVII., 40, tab. 8, fig. 20, 1858 (Rio Guaporé); Günther, Cat. Fish. Brit. Mus., V., 328, 1864; Steind., Flussfische, Südamerika's, IV., 32, 1882 (Tabatinga; Cudajas; Obidos; Villa Bella); Eigenm. & Eigenm., Proc. U. S. Nat. Mus., XIV., 53, 1891.

*Habitat*:—Amazons from Obidos to Tabatinga; Guaporé.

66. **Tetragonopterus alburnus** Hensel.

Wiegman, Archiv., 85, 1870 (Rio Cadea) : Steind., Süßwf., Südöstl., Bras., III., 24, 1876 (Rio Cadea) ; Eigenmann & Eigenmann, Proc. U. S. Nat. Mus., XIV., 53, 1891.

*Habitat*:—Rio Cadea.

67. **Tetragonopterus gronovii** Kner & Steindachner.

Neue Fische aus Centr. Am., 46, 1864 (Rio Bayano) ; Eigenmann & Eigenmann, Proc. U. S. Nat. Mus., XIV., 53, 1891.

*Habitat*:—Rio Bayano.

68. **Tetragonopterus dichrouus** Kner.

Denkschr., Acad. Wiss. Wien, XVII., 177, tab. 9, fig. 9, 1859 (Rio Guapore ; Caicara ; Paraguay) ; Günther, Cat. Fish. Brit. Mus., V., 324, 1864 ; Eigenmann & Eigenmann, Proc. U. S. Nat. Mus., XIV., 53, 1891.

*Habitat*:—Rio Guapore ; Caicara ; Paraguay.

69. **Tetragonopterus phœnicopterus** Cope.

Proc. Acad. Sci. Phila., 260, 1871 (Ambyiacu) ; Eigenmann & Eigenmann, Proc. U. S. Nat. Mus., XIV., 54, 1891.

*Habitat*:—Ambyiacu.

70. **Tetragonopterus orientalis** Cope.

Proc. Amer. Philos. Soc., 559, 1870 (Para) ; Eigenmann & Eigenmann, Proc. U. S. Nat. Mus., XIV., 54, 1891.

*Habitat*:—Para.

71. **Tetragonopterus panamensis** Günther.

Cat. Fish. Brit. Mus., V., 324, 1864 (Pacific coast of Panama ; Yzabal) ; Gill, Proc. Phila. Acad., 336, 1876 (Rio Frijoli) ; Eigenmann & Eigenmann, Proc. U. S. Nat. Mus., XIV., 52, 1891.

*Tetragonopterus fischeri* Steind. Flussfische Südamerica's, I., 18, 1879, pl. I., fig. 1-2 (Mamoni River, Panama).

*Habitat*:—Panama ; Yzabal ; Rio Frijoli ; Mamoni River.

72. **Tetragonopterus carolinæ** (Gill).

*Astyanax carolinæ* Gill, Proc. Phila. Acad. Sci., 92, 1870 (River Napo or Marañon).

*Tetragonopterus carolinæ* Eigenmann & Eigenmann, Proc. U. S. Nat. Mus., XIV., 53, 1891.

*Habitat*:—River Napo or Marañon.

73. **Tetragonopterus scabripinnis** Jenyns.

Zoöl. Beagle, Fish. p. 125, pl. 23, fig. 3, 1842 (Rio de Janeiro) ; Günther, Cat. Fish. Brit. Mus., V. 325, 1864 (in part) ; Eigenmann & Eigenmann, Proc. U. S. Nat. Mus., XIV., 53, 1891.

*Habitat*:—Rio de Janeiro.

**74. *Tetragonopterus rutilus* Jenyns.**

*Tetragonopterus rutilus* Jenyns, Zool. Beagle, Fish., p. 125, pl. 23, fig. 2, 1842; Steind., Ichthyol. Not., IX., 10, pl. II., fig. 2, 3, 1869 (Montevideo); Hensel, Wieg. Arch., 80, 1870; Steind., Süswf. Südöstl. Bras., III., 575, pl. II., figs. 1, 2, 1896 (Rio Parahyba; Rio Doce; Montevideo; Rio Janeiro; Rio Jequitinhonha; Xamapa, Mexico); *id.* Fish. Cauca & Flüsse bei Guayaquil, 22, 1880 (Cauca); Boulenger, Proc. Zool. Soc., 281, 1887 (Canelos); *id.* Ann. & Mag. Nat. Hist., XIV., 173, 1887 (Rio Grande do Sul); Eigenm. & Eigenm., Proc. U. S. Nat. Mus., XIV., 52, 1891; Eigenm. Ann. N. Y. Acad. Sci., 1894 (Rio Grande do Sul); Cope, Proc. Am. Philos. Soc., XXXIII., 87, 1894 (Rio Grande do Sul).

*Tetragonopterus fasciatus* Cuv. & Val., XXII., p. 140; Günther, Cat. Fish. Brit. Mus., V., 322, 1864 (not synon. Brazil, West Ecuador; Huamuchal Rio Guacalate; Rio Chisoy, Vera Paz, Mexico; Cordova; Central America; Guatemala); *id.* Ann. & Mag. Nat. Hist., 1880 (La Plata).

*Tetragonopterus scabripinnis* Kner. (not Jen.), Denkschr. Acad. Wiss. Wein., XVII., 175, 1858 (♂) (Xamapa, Mexico; Trisanga); Günther, Cat. Fish. Brit. Mus., V., 325, 1864 (in part).

*Tetragonopterus microstoma* Günther, Cat. Fish. Brit. Mus., V., 323, 1864; *id.* Ann. & Mag. Nat. Hist., 1880 (La Plata).

*Tetragonopterus wneus* Hensel, Wieg. Arch., I., 87, 1868 (Southern Brazil).

*Tetragonopterus curieri* Lütken, Overs. Dan. Selsk., No. 3, 131, 1874 (Rio San Francisco and Rio das Velhas with its tributaries); *id.* Velhas-Flodens Fiske, XIII., 210, pl. V., fig. 12, 1875 (Rio das Velhas).

*Habitat*:—Brazil, West Ecuador; Mexico; Central America.

**75. *Tetragonopterus rutilus* jequitinhonhæ Steindachner.**

Süswf. Südöstl. Bras., III., 27, pl. II., fig. 3, 1876 (Rio Jequitinhonhæ); Eigenm. & Eigenm., Proc. U. S. Nat. Mus., XIV., 52, 1891.

*Habitat*:—Rio Jequitinhonhæ.

**76. *Tetragonopterus petenensis* Günther.**

Cat. Fish. Brit. Mus., V., 326, 1864 (Lake Peten; W. Ecuador); *id.* Ann. & Mag. Nat. Hist., VI., Ser. 5, 12, 1880 (Rio Negro; Argentine Rep.); Eigenm. & Eigenm., Proc. U. S. Nat. Mus., XIV., 53, 1891.

*Habitat*:—Rio Negro; Argentine Republic; Lake Peten; Western Ecuador.

**77. *Tetragonopterus microphthalmus* Günther.**

Cat. Fish. Brit. Mus., V., 324, 1864 (Pacific Coast of Guatemala; Lake Amatitlan; Rio Rimac); Eigenm. & Eigenm., Proc. U. S. Nat. Mus., XIV., 52, 1891.

*Habitat*:—Pacific Coast of Guatemala; Lake Amatitlan; Rio Rimac.

78. **Tetragonopterus æneus** Günther.

Proc. Zool. Soc., p. 319, 1860; Günther, Cat. Fish. Brit. Mus., V., 326, 1864 (Oaxaca); Hensel, Wiegman, Archiv., 87, 1870 (Rio Cadea; Porto Alegre); Eigenmann & Eigenmann, Proc. U. S. Nat. Mus., XIV., 53, 1891.

*Habitat*:—Rio Cadea; Porto Alegre; Oaxaca.

79. **Tetragonopterus chrysargyreus** Günther.

Cat. Fish. Brit. Mus., V., 328, 1864 (Essequibo); Eigenmann & Eigenmann, Proc. U. S. Nat. Mus., XIV., 53, 1891.

*Habitat*:—Essequibo.

80. **Tetragonopterus lineatus** Perugia.

Ann. Mus. Genov., (2) X., 644, 1891 (Matto Grosso, River Paraguay); *id.* Ichthyol., Beitr., XV., 26, 1891 (Iquitos).

*Tetragonopterus steindachneri*, Eigenmann, Proc. U. S. Nat. Mus., XVI., 53, 1893.

*Habitat*:—Matto Grosso, River Paraguay; Iquitos.

81. **Tetragonopterus grandisquamis** Müller & Troschell.

Hor. Ichth., I., 27, taf. 8, fig. 2, 1845 (Surinam); Günther, Cat. Fish. Brit. Mus., V., 328 (British Guiana); Eigenmann & Eigenmann, Proc. U. S. Nat. Mus., XIV., 53, 1891.

*Habitat*:—British Guiana; Surinam; Brazil. Four specimens from Itaituba; Brazil, one specimen.

82. **Tetragonopterus bahiensis** Steindachner.

Süssw. südöstl. Bras., III., 13, 1876 (Bahia); Eigenmann and Eigenmann, Proc. U. S. Nat. Mus., XIV., 52, 1891.

*Habitat*:—Bahia.

83. **Tetragonopterus collettii** Steindachner,

Flussfische Südamerika's, IV., 33, pl. VII., fig. 3, 1882 (Obidos; Hyavary); Eigenmann & Eigenmann, Proc. U. S. Nat. Mus., XIV., 53, 1891.

*Habitat*:—Obidos; Hyavary.

84. **Tetragonopterus xinguensis** Steindachner.

Flussfische Südamerika's, IV., 32, 1882 (Xingu); Eigenmann & Eigenmann, Proc. U. S. Nat. Mus., XIV., 53, 1891.

*Habitat*:—Xingu.

85. **Tetragonopterus agassizii** Steindachner.

Ichthyol. Beitr. V., 41, pl. VIII., fig. 2, 1876 (Tabatinga; Cudajas); Cope, Proc. Amer. Philos. Soc., 691, 1878 (Peruvian Amazon); Eigenmann & Eigenmann, Proc. U. S. Nat. Mus., XIV., 53, 1891.

*Habitat*:—Peruvian Amazon; Cudajas; Tabatinga.



86. **Tetragonopterus ovalis** Günther.

Proc. Zool. Soc., 245, 1868 (Xeberos); Eigenm. & Eigenm., Proc. U. S. Nat. Mus., XIV., 54, 1891.

*Habitat*:—Xeberos.

87. **Tetragonopterus oligolepis** Günther.

Cat. Fish. Brit. Mus., V., 327, 1864 (British Guiana); Eigenm. & Eigenm., Proc. U. S. Nat. Mus., XIV., 53, 1891.

*Habitat*:—British Guiana.

88. **Tetragonopterus pulcher** (Gill).

Ann. Lyc. Nat. Hist. N. Y., 1858, 419 (Trinidad).

*Habitat*:—Trinidad.

89. **Tetragonopterus mexicanus** Filippi.

Rev. et Magaz. de Zoölogie, 1853, p. 166; Steind., Ichthyol. Not. IX., 11, 1869, pl. IV., figs. 1–4 (Lake Mexico, Izucar); Eigenm., Proc. U. S. Nat. Mus., XVI., 55, 1893.

*Tetragonopterus brevipinnatus* Günther, Cat. Fish. Brit. Mus., V., 325, 1864 (Guatemala; Yzabal; Rio S. Geronimo).

*Habitat*: Lake Mexico; Guatemala; Rio S. Geronimo.

90. **Tetragonopterus argentatus** (Baird and Girard).

*Astyanax argentatus*, Baird and Girard, Proc. Acad. Nat. Sci. Phila., VII., 27, 1854; Girard, U. S. Mex. Bound. Survey, 74, 1859 (Rio Nueces; Rio Leona; Zoquito; Comanche Springs; Elm Creek; San Felipe; Devil's River; Brownsville; Mouth of Rio Grande; Rio Sabinal).

*Tetragonopterus argentatus* Jordan and Gilbert, Syn. Fish. North Amer., 255, 1883 (Arkansas to Mexico); Eigenm., Proc. U. S. Nat. Mus., XVI., 56, 1893.

*Habitat*:—Texas; Mexico.

This species may prove identical with *T. mexicanus* Filippi.

91. **Tetragonopterus copei** Steindachner.

Flussfische Südamerika's, IV., 35, pl. VI., fig. 6, 1882 (Santarem); Eigenm. & Eigenm., Proc. U. S. Nat. Mus., XIV., 53, 1891.

*Habitat*:—Santarem; Itaituba; Para; Brazil.

One specimen from Itaituba, nineteen are recorded from Brazil. Three of the specimens from Brazil have inconspicuous caudal and humeral spots, and in thirteen of them the spots are very evident. Eight specimens from the Lower Amazons and one from Para.

92. **Tetragonopterus diaphanus** Cope.

Proc. Amer. Philos. Soc., 691, 1878 (Peruvian Amazon); Eigenm. & Eigenm., Proc. U. S. Nat. Mus., XIV., 53, 1891.

*Habitat*:—Peruvian Amazon.

**93. *Tetragonopterus santaremensis* sp. nov.**

Body moderately elongate, the caudal peduncle rather slender. Head  $3\frac{1}{2}$ , depth  $3\frac{1}{2}$  in the body. The origin of the dorsal fin is just behind the base of the ventrals. The anterior dorsal and anal rays elongate. The pectoral reaches a little beyond the origin of the ventral, the ventral extends somewhat beyond the front margin of the anal. Caudal deeply lobed.

Snout short, 4 in the head; diameter of the eye somewhat more than the width of the interorbital and  $2\frac{1}{2}$  in the head. The maxillary with no teeth extends to a vertical line touching the anterior margin of the pupil of the eye. The humeral spot and lateral band are much as in *bellottii*, the caudal spot is somewhat more rhomboidal and extends to the end of some of the rays in all of the specimens. The posterior part of the caudal spot is darker than the anterior. The edges of the scales, especially above the lateral line, are marked with a deeper brown color, giving the sides of the body a reticulate appearance. A faint line on either side of the dorsal has also this color and extends backward and forward. A similar line along either side of the anal. There are faint blotches on some of the anal and dorsal rays.

D. 10, A. 20-22, scales 5-30-3, lateral line complete.

*Habitat*:—Santarem; ten specimens 22-24 mm. long.

Related to *copei* and *diaphanus*.

**94. *Tetragonopterus jenynsii* Steindachner.**

Süsswf. Südöstl. Bras., III., 22, pl. III., fig. 1-2, 1876 (Rio Parahyba); Eigenm. & Eigenm., Proc. U. S. Nat. Mus., XIV., 53, 1891.

*Habitat*:—Rio Parahyba.

**95. *Tetragonopterus paucidens* sp. nov.**

Related to *diaphanus*.

Body rather elongate, dorsal and ventral outline nearly equally curved. Dorsal fin equidistant from the tip of the snout and base of the caudal. (The ventral fins were destroyed.) Head  $3\frac{1}{2}$ , depth  $2\frac{3}{4}$  in the length. Snout  $3\frac{1}{2}$ , diameter of the eye 3 in the head. Maxillary with two small teeth, extends to a vertical line touching the anterior border of the pupil. A silvery lateral band present and a diffuse caudal spot, no humeral spot. Caudal peduncle stout, D. 11, A. 19. Scales 5-31-3, lateral line complete.

*Habitat*:—Itaituba. One specimen 45 mm. long.

**96. *Tetragonopterus fasciatus* (Cuvier).**

*Chalceus fasciatus* Cuv., Mem. Mus., V., p. 352, pl. 26, fig. 2, 1817; Schomburgk. Fish. Brit. Guian., I., 215, 1841 (Paduiri).

*Tetragonopterus fasciatus* Steind., Ichthyol. Not., IX., 8, 1869, fig. 1 (Montevideo); *id.*, Ichthyol. Beitr., V., 578, pl. I., fig. 3, 1876; *id.*, Süsswf. Südöstl. Bras., III., 20, pl. I., fig. 3, 1876 (Rio Janeiro; Rio Parahyba; Rio Jequitinhonha); Eigenm. & Eigenm., Proc. U. S. Nat. Mus., XIV., 52, 1891; Eigenm., Ann. N. Y. Acad. Sci., 1894 (Rio Grande do Sul).

*Tetragonopterus rivularis* Lütken, Overs. Dan. Selk., No. 3, 132, 1874 (Rio das Velhas and affluents); *id*, Velhas-Flodens Fiske, XIII., 215. pl. V., figs. 13 and 14, 1875 (Rio das Velhas).

*Tetragonopterus eigenmanniorum* Cope, Proc. Amer. Philos. Soc., XXXIII., 89, 1894 (Rio Grande do Sul).

*Tetragonopterus laticeps* Cope.

A comparison of the excellent description and plate of *eigenmanniorum* with numerous specimens from Rio Grande do Sul leaves little doubt but that this is one of the variations of *fasciatus*. *T. laticeps*, which is also very well described and figured may prove to be the same; the only character that separates them is the absence of maxillary teeth in *laticeps*, but the single tooth that is sometimes present in the maxillary of *fasciatus* may very readily be mistaken for an inter-maxillary tooth.

The following table has been compiled to show the extent of the known variations of the species:

| <i>eigenmanniorum</i> .          | <i>laticeps</i> .          | (Eigenm).<br><i>fasciatus</i> . | (Steind).<br><i>fasciatus</i> . | (Lütken).<br><i>rivularis</i> . |
|----------------------------------|----------------------------|---------------------------------|---------------------------------|---------------------------------|
| Scales 7-32 to 36-6              | 6-37-4½                    | 6 or 7-32 to 36-4 to 6          | 6½, 38 to 40-5                  | 5 to 6-33 to 38-6 or 7          |
| D. 11                            | D. 11                      | D. 11*                          | D. 10                           | D. 11                           |
| A. 23 to 24                      | A. 20                      | A. 2 or 3, 19 to 25             | A. 18-20                        | A. 19-20                        |
| Head 4                           | 3.75 to 4                  | 4                               | 4½                              | 4                               |
| Eye 3 in head=in-<br>terorbital. | 3 to 3½ L<br>interorbital. | 2⅔-4                            | 3                               | 3                               |
| Depth 2½                         | 2.6                        | 2½-3                            | 2½                              | 2¾-3                            |
| No maxillary teeth               | No max.<br>teeth.          | Max. 1-3 teeth.                 |                                 | Max. teeth 1-3.                 |

*Habitat*:—Brazil; British Guiana.

#### 97. *Tetragonopterus fasciatus interrupta* Lütken.

*Tetragonopterus rivularis interrupta* Lütken, Velhas-Flodens Fiske, XIII., 215, 1875; Eigenm., Ann. N. Y. Acad. Sci., 1894 (Rio Grande do Sul).

*Tetragonopterus lütkenii* Boul. Ann. Mag. Nat. Hist., 1887 (Rio Grande do Sul).

The description of *lütkenii* leaves little doubt but that it is identical with specimens in the museum of Indiana University from the Rio Grande do Sul. These specimens are in all probability the *T. rivularis* of Lütken which has an interrupted lateral line.

#### 98. *Tetragonopterus jacuhiensis* Cope.

Proc. Amer. Philos. Soc., XXXIII., 88, 1894 (Rio Grande do Sul).

\*The number 10 in Eigenmann, Ann. N. Y. Acad. Sci., VII., 624, 1894, should be 11.

This species may prove to be identical with *T. maculatus lacustris* Lütken.

*lacustris.*  
Head  $4\frac{1}{4}$ .  
Depth  $2\frac{1}{3}$ .  
A. 24-32.  
Scales 6-34-36-6 to 7.  
Eye 3 in head.

*jacuhiensis.*  
Head 4.  
Depth  $2\frac{1}{4}$ .  
A. 27-28.  
Scales 6 to 7-36-6 $\frac{1}{2}$ .  
Eye 4 in head.

Humeral spot longitudinally ovate, pale area surrounding it, not bordered posteriorly by vertically curved border.

Humeral spot vertically elongate, situated in the centre of a pale area which is bounded posteriorly by a vertically curved border.

99. **Tetragonopterus iheringii** Boulenger.

Ann. Mag. Nat. Hist., 172, 1887 (Rio Grande do Sul).

*Tetragonopterus obscurus* Eigenm. (not Hensel), Ann. N. Y. Acad. Sci., 1894 (Rio Grande do Sul).

*Tetragonopterus pliodus* Cope, Proc. Am. Philos. Soc. XXXIII., 90, 1894 (Rio Grande do Sul).

*Tetragonopterus pliodus* cope is unquestionably identical with specimens sent by Dr. von Ihering to Indiana University from Rio Grande do Sul. On comparison of these specimens, which were identified by Dr. Eigenmann as *T. obscurus*, with the description of *T. iheringii* there remains little doubt but they belong to the species described by Boulenger. The faint caudal and humeral spots almost disappear in some specimens. I have therefore placed *pliodus* in the synonymy of *iheringii*.

100. **Tetragonopterus orstedii** Lütken.

Vidensk. Medd. Nat. For. Kjöb., 229, 1874 (Rio S. Juan, Central Amer.).

*Habitat*:—Rio S. Juan, Central America.

101. **Tetragonopterus unilineatus** Gill.

*Pecilurichthys Hemigrammus unilineatus* Gill, Fresh Water Fishes Trinidad, 60, 1858 (Trinidad); Günther, Cat Fish. Brit. Mus., V., 317, 1864.

*Tetragonopterus unilineatus* Eigenm & Eigenm., Proc. U. S. Nat. Mus., XIV, 54, 1891.

*Habitat*:—Trinidad; Para; Brazil.

Brazil, seven specimens, the color of body very dark silvery.

Para, fifteen specimens.

102. **Tetragonopterus elegans** Steindachner.

Flussfische Südamerika's, IV., 36, pl. VII., fig. 4, 1882 (Obidos); Eigenm. & Eigenm., Proc. U. S. Nat. Mus., XIV., 53, 1891.

*Habitat*:—Obidos.

**103. *Tetragonopterus gracilis* Reinhardt.**

Lütken, Overs. Dan. Selsk., No. 3, 133, 1874 (Lagoa Santa); *id.* Velhas-Flodens Fiske, XIV., 218, pl. V. fig. 17, 1875 (Rio das Velhas); Eigenm. & Eigenm., Proc. U. S. Nat. Mus., XIV., 53, 1891.

*Habitat*:—Lagoa Santa; Rio das Velhas.

**104. *Tetragonopterus nanus* Reinhardt.**

Lütken, Overs. Dan. Selsk. No. 3, 133, 1874 (Lago Santa); *id.* Velhas-Flodens Fiske, XIV., 218, pl. V. fig. 17, 1875 (Rio das Velhas); Eigenm. & Eigenm., Proc. U. S. Nat. Mus., XIV., 54, 1891.

*Habitat*:—Lago Santa; Rio das Velhas.

**105. *Tetragonopterus bellottii* Steindachner.**

Flussfische Südamerika's, IV., 34, 1882 (Tabatinga); Eigenm. & Eigenm., Proc. U. S. Nat. Mus., XIV., 53, 1891.

*Habitat*:—Tabatinga; Santarem. Twenty-one specimens from Santarem.

**106. *Tetragonopterus schmardæ* Steindachner.**

Flussfische Südamerika's, IV., 37, pl. VII., fig. 6, 1882 (Tabatinga); Eigenm. & Eigenm., Proc. U. S. Nat. Mus., XIV., 54, 1891.

*Habitat*:—Tabatinga; Para; Brazil.

Three specimens from the lower Amazons, seven from Para and eleven are marked Brazil. About fifteen scales of the lateral line are perforated. A darker line of the diffuse caudal spot extends to the end of some of the rays, the very evident humeral spot bordered above by the anterior end of an indistinct silvery lateral band.

**107. *Tetragonopterus ocellifer* Steindachner.**

Flussfische Südamerika's, IV., 32, pl. VII., fig. 5, 1882 (Villa Bella; Cudajas); Eigenm. & Eigenm., Proc. U. S. Nat. Mus., XIV., 54, 1891.

*Habitat*:—Villa Bella; Cudajas.

**108. *Tetragonopterus robustulus* Cope.**

*Hemigrammus robustulus* Cope, Proc. Amer. Philos. Soc., 561, 1870 (Petas); *id.*, Proc. Amer. Philos. Soc., 690, 1878 (Peruvian Amazon).

*Habitat*:—Petas; Peruvian Amazon.

**109. *Tetragonopterus heterorhabdus* sp. nov.**

Related to *schmardæ*.

Body moderately elongate, tapering rapidly from the posterior end of the dorsal and anterior of the anal to the base of the rather slender caudal peduncle. Dorsal inserted about midway between the tip of the snout and base of

the caudal and over the space between the anal and ventral. Anal with first six rays elongate. Maxillary toothless, extends nearly to the centre of the pupil of the eye. The dark brown lateral band deepest colored anteriorly, edged above by a conspicuous silvery band. No caudal spot or true humeral spot, the anterior end of the lateral band suddenly expands more or less, presenting the appearance somewhat of a humeral spot.

Head  $3\frac{1}{2}$ , depth  $3\frac{1}{2}$ ; eye in the head  $2\frac{1}{2}$ , and once in the interorbital. A. 20-23. D. 10, scales 32-34. Lateral line incomplete, only about 6 scales perforated.

*Habitat*:—Para; Brazil. Many specimens 10-20 mm. long.

**110. *Tetragonopterus orbignyanus* Cuv. & Val.**

Cuv. & Val., XXII., p. 147 (Buenos Ayres); Günther, Cat. Fish. Brit. Mus., V., 317, 1864; Eigenm. & Eigenm., Proc. U. S. Nat. Mus., XIV., 53, 1891.

*Habitat*:—Buenos Ayres.

**111. *Tetragonopterus ortonii* Gill.**

Proc. Phila. Acad. Sci., 92, 1879 (Marañon and Napo); Eigenm. & Eigenm., Proc. U. S. Nat. Mus., XIV., 54, 1891.

*Habitat*:—Marañon and Napo.

**112. *Tetragonopterus bartlettii* Günther.**

Ann. Mag. Nat. Hist., XVIII., 30, 1866 (Upper Amazons); Cope, Proc. Acad. Nat. Sci. Phila., 260, 1871 (Ambyiaeu); Eigenm. & Eigenm., Proc. U. S. Nat. Mus., XIV., 53, 1891.

*Habitat*:—Upper Amazons.

**113. *Tetragonopterus lütkenii* Boulenger.**

Ann. & Mag. Nat. Hist., XIX., 173, 1887 (Rio Grande do Sul); Eigenm. & Eigenm., Proc. U. S. Nat. Mus., XIV., 53, 1891.

*Habitat*:—Rio Grande do Sul.

**114. *Tetragonopterus erythropterus* Holmberg.**

Holmberg, Rev. Argent., I., 1891, p. 189 (Rio de la Plata).

*Habitat*:—Rio de la Plata.

**115. *Tetragonopterus belizianus* Bocourt.**

Bocourt in Ann. Sci. Nat., 1868, IX., 62 (Belize).

*Habitat*:—Belize.

**116. *Tetragonopterus cobanensis* Bocourt.**

Loc. cit., 62 (Rivers of Coban).

*Habitat*:—Rivers of Coban.

117. **Tetragonopterus finitimus** Bocourt.

Loc. cit., 62 (Orizaba).

*Habitat*:—Orizaba.118. **Tetragonopterus fulgens** Bocourt.

Loc. cit., 62 (Province of Cuernavaca).

*Habitat*:—Province of Cuernavaca.119. **Tetragonopterus nitidus** Bocourt.

Loc. cit., 62 (De Taseo).

*Habitat*:—De Taseo.120. **Tetragonopterus oaxacanensis** Bocourt.

Loc. cit., 62 (Oaxaca).

*Habitat*:—Oaxaca.121. **Tetragonopterus correntinus** Holmberg.

Holmberg, Rev. Argent. I., 1891, p. 189 (Rio Parana, Corrientes).

*Habitat*:—Rio Parana.122. **Tetragonopterus sawa** Castlenau.

Anim. Amer. Sud. Poiss. p. 65, pl. 33, fig. 1, 1855 (Rio Crixas); Günther, Cat. Fish. Brit. Mus., V., 317, 1864; Eigenm. &amp; Eigenm., Proc. U. S. Nat. Mus., XIV., 53, 1891.

*Habitat*:—Rio Crixas.123. **Tetragonopterus viejita** Cuv. & Val.

Cuv. &amp; Val., XXII., p. 154 (Lake of Maracaïbo); Günther, Cat. Fish. Brit. Mus., V., 317, 1864; Eigenm. &amp; Eigenm., Proc. U. S., Nat. Mus., XIV., 53, 1891.

*Habitat*:—Lake Maracaïbo.**CHEIRODON** Girard.*Tetragonopterus* sp. Jenyns.*Cheirodon* Girard, Proc. Acad. Nat. Sci. Phila., VI., 199, 1854 (*pisciculus*).*Odontostilbe* Cope, Proc. Amer. Philos. Soc. 566, 1870 (*fugitiva*).*Cheirodon* Eigenm. & Eigenm., Proc. U. S. Nat. Mus., XIV., 54, 1891.Type: *Cheirodon pisciculus* Girard.*Synopsis of the Species of Cheirodon.*

- a. Teeth multipointed incisors.....CHEIRODON Girard.
- b. Lateral line complete.....(ODONTOSTILBE Cope.)
- c. An oblique dark bar on the upper part of dorsal. Maxillary with teeth along its entire length. A well defined silvery band on posterior part of

- body. Caudal spot very small but well defined. Humeral spot usually absent. Dorsal in the middle of the length, behind origin of ventral. Mouth very small, head  $3\frac{3}{4}$ , depth  $3\frac{1}{4}$ . Eye  $2\frac{2}{3}$ – $2\frac{3}{4}$  in the length of the head. Height of dorsal equals length of head. Caudal lobes longer than the head. D. 11, A. 22, lateral line 35–36.....124. **pequira**.
- cc. Dorsal plain, maxillary with but two or three teeth.
- d. Depth  $2\frac{2}{3}$ – $2\frac{3}{4}$  in the length. Maxillary with but three teeth. Intermaxillary with but 5 teeth on each side, each with 9 points, the median most prominent. D. 10 or 11, A. 22–25, lateral line 33–34. Humeral and caudal spots indistinct. Head 4, depth  $3\frac{1}{2}$  in the length.....125. **pulcher**.
- dd. Depth  $3\frac{1}{2}$  in the length, maxillary with two teeth. D. 10, A. 24, lateral line 35. Five teeth in each pre-maxillary and six on each dentary; pre-maxillary teeth with seven cusps each, the median most prominent; those of the other bones with similar cusps of more equal length. Head 4, eye in the head  $2\frac{1}{2}$ . A silvery band; a dark spot on the caudal peduncle..... 126. **fugitiva**.
- bb. Lateral line incomplete.....(CHEIRODON Girard).
- e. Maxillary without teeth. A. 19–23, D. 11, lateral line 35, depth  $2\frac{1}{2}$ , head 4; pectorals extend beyond ventrals. A bright longitudinal band on the sides; a black spot at the base of the caudal....127. **interruptus**.
- ee. Maxillary with a single crenate tooth. Depth 2.6; head 3.6; eye large 3 times in the head. Scales 3–32–4 $\frac{1}{2}$ . D. 10; A. 19–22. Pectoral reaching the ventral and ventral nearly reaching the anal. Lateral line on 9–10 scales. An indistinct narrow, dusky line on the middle of the side from the caudal fin to below the dorsal....128. **monodon**.
- eee. Maxillary with more than one tooth.
- f. Anal short, of but 14 rays. D. 10; teeth usually five-pointed. A silvery lateral band margined above with black. Depth 3–4 in "the total length"; head 5, eye 3 in the head....129. **pisciculus**.
- ff. Anal with 19–26 rays.
- g. Scales 30–32. A black spot at base of caudal.
- h. Anal 23–26. No humeral spot, an intense dark violet spot on the base of the caudal and continued to the tip of the middle rays. A light yellow spot just behind the dark caudal spot on the upper and lower caudal rays. A conspicuous violet stripe from behind the ventrals along the entire base of the anal, a branch extending from the base of the first three or four anal rays obliquely to the tip of the 6th and 7th rays and back along the remaining rays. Head  $3\frac{1}{3}$ – $3\frac{1}{2}$ , depth  $3\frac{1}{2}$ – $3\frac{3}{4}$ . D. 9–10. Lateral line 30. Mouth very oblique, lower jaw projecting; teeth numerous, very small and slender. Interorbital bones entirely covering the lower cheeks.....130. **nattereri**.
- hh. Anal 19; humeral spot when present not conspicuous; caudal spot not continued to the tips of the middle rays. Lower



- accessory rays of the caudal spine-like. D. 11. Lateral line 30-31. Head  $3\frac{2}{3}$ - $3\frac{1}{2}$  depth  $2\frac{4}{5}$ -3, eye little more than 2 in the head. .... 131. *insignis*.  
 gg. Scales about 35 in a longitudinal series. Intermaxillary teeth 5, mandibular 7, maxillary 2-3. Depth 3 in the length. D. 11, A. (3+20) 23. Eye 3 in the head, no caudal spot, 9-10 tubes in the lateral line. .... 132. *piaba*.

124. **Cheirodon pequirá** (Natterer).

*Salmo pequirá* Natterer in MS.

*Cheirodon pequirá* Steind., Anz. AK. Wien, 180, 1882 (Rio Guaporé); *id.* Flussfische Südamerika's, IV., 38, 1882 (Cujaba).

*Cheirodon pequirá* Eigenm. & Eigenm., Proc. U. S. Nat. Mus., XIV., 54, 1891.

*Habitat*:—Rio Cuaporé; Cujaba.

125. **Cheirodon pulcher** Gill.

*Pocilurichthys pulcher* Gill, Ann. Lyc. Nat. Hist., VI., 59, 1858 (Trinidad).

*Cheirodon* (*Odontostilbe*) *pulcher* Lütken, Overs. Dan. Selsk.; 236, 1874.

*Odontostilbe pulcher* Eigenm. & Eigenm., Proc. U. S. Nat. Mus., XIV., 54, 1891.

*Habitat*:—Trinidad.

126. **Cheirodon fugitiva** (Cope).

*Odontostilbe fugitiva* Cope, Proc. Amer. Philos. Soc., 566, 1870, with fig. — (Petrás); Eigenm. & Eigenm., Proc. U. S. Nat. Mus., XIV.; 54, 1891.

*Habitat*:—Brazil; Petras (one specimen.)

127. **Cheirodon interruptus** (Jenyns).

*Tetragonopterus interruptus* Jenyns, Voy. Beagle, Fish. p. 127, tab. 23, fig. 4, 1842 (Maldonado).

*Cheirodon interruptus* Günther, Cat. Fish. Brit. Mus., V., 332, 1864.

*Cheirodon interruptus* Eigenm. & Eigenm., Proc. U. S. Nat. Mus., XIV., 54, 1891.

*Habitat*:—Maldonado.

128. **Cheirodon monodon** Cope.

*Cheirodon monodon* Cope, Proc. Amer. Philos. Soc., XXXIII., 91, 1894.

*Habitat*:—Rio Grande do Sul.

129. **Cheirodon pisciculus** Girard.

Proc. Acad. Nat. Sci. Philad., VII., 199, 1854; *id.* U. S. Nav. Astronom. Exped. Fishes., p. 249, pl. 34, figs. 4, 7, 1855 (Santiago, Chile); Eigenm. & Eigenm., Proc. U. S. Nat. Mus., XIV., 54, 1891.

*Cheirodon pisciculus* Günther, Cat. Fish. Brit. Mus., V., 332, 1864.

*Habitat*:—Chile (Santiago).

**130. *Cheirodon nattereri* Steindachner.**

*Cheirodon nattereri* Steind., Anz. AK. Wien, 180, 1882 (Obidos).

*Cheirodon nattereri* Eigenm. & Eigenm., Proc. U. S. Nat. Mus., XIV., 54, 1891.

*Cheirodon pulcher* Steind., Flussfische Südamerika's, IV., 39, 1882 (Villa Bella).

*Cheirodon pulcher*, Eigenm. & Eigenm., Proc. U. S. Nat. Mus., XIV., 54, 1891.

*Cheirodon steindachneri* Eigenm. & Eigenm., Proc. U. S. Nat. Mus., XVI., 53, 1893 (foot note).

*Habitat*:—Obidos; Villa Bella; Para (four specimens).

I have not seen the Anz. K. K. AK. Wiss. Wien, 1882, but presume that the new species of *Cheirodon* there proposed are identical with those described in the Flussfische IV. If so *nattereri* and *pulcher* are used for the same species. Since *pulcher* is pre-occupied the name *nattereri* is to be used. If the two names are not used interchangeably by Steindachner the name *steindachneri* must be used for *pulcher*.

**131. *Cheirodon insignis* Steindachner.**

Fisch Fauna des Cauca und Flüsse bei Guayaquil, 22, pl. VI., fig. 3, 1880 (Villa Bella); Eigenm. & Eigenm., Proc. U. S. Nat. Mus., XVI., 54, 1891.

*Habitat*:—Villa Bella; Brazil (four specimens); Para (thirteen specimens).

**132. *Cheirodon piaba* Lütken.**

*Cheirodon piaba* Lütken, Overs. Dan. Selsk., No. 3, 134, 1874 (Rio das Velhas); *id.* Velhas-Flodens Fiske, XIV., 219, 1875 (Rio das Velhas).

*Cheirodon piaba* Eigenm. & Eigenm., Proc. U. S. Nat. Mus., XIV., 54, 1891.

*Habitat*:—Rio das Velhas.

**APHYOCARAX** Günther.

*Aphyocarax* Günther, Proc. Zool. Soc., 245, 1868 (*pusillus*).

*Aphyocarax* Eigenm. & Eigenm., Proc. U. S. Nat. Mus., XIV., 55, 1891.

*Synopsis of the Species of **Aphyocarax**.*

aa. Teeth pointed, with a minute cusp on each side.\*

i. Anal short, of 18–23 rays.

j. Lateral line 36 or 37. Middle caudal rays black, dorsal plain, no humeral spot.

\* Not examined in *eques* Steind.

- k. D. 9, A. 18, V. 8, lat. 1. 36, 8 tubes. Head  $4\frac{1}{2}$ , depth  $4\frac{1}{2}$  in the length; eye  $3\frac{1}{2}$  in the head; maxillary extending beyond the anterior margin of the orbit. Intermaxillaries with 14, mandibles with 18 teeth; maxillary teeth very small occupying about one third of the length of the bone. Caudal slightly forked. Color uniform olive.  
133. **pusillus**.
- kk. D. 10, A. 20, lat. 1. 37. Depth little more than length of head which is 4 in the length of body; 12 teeth in the upper, 18 in the lower jaw. ....134. **alburnus**.
- jj. Lateral line 30. Caudal plain, a dark spot on the upper half of first dorsal rays, a smaller one near tip of anterior anal rays. Humeral spot small. Maxillary with microscopic teeth along its entire length.  
135. **maxillaris**.
- ii. Anal long, of 27-30 rays.
- l. Scales 30-33. No caudal spot, a large black spot on the dorsal fin.
- m. *Entire edge of maxillary toothed*. A. 27, lateral line 30; depth 3, head  $3\frac{1}{2}$ . Anterior anal rays elevated, forming a projecting lobe beyond the rest of the fin. Edge of the shorter anal rays dark, this color continued on the elongate rays, dividing them near their middle. A violet spot on upper anterior part of dorsal higher than long. ....136. **agassizii**.
- mm. Upper part of maxillary toothed.
- n. *A vertical band-like humeral spot*; a large dark spot covering nearly the entire dorsal. A. 30, lat. 1. 33, depth  $2\frac{1}{2}$ , head 3. Entire edge of anal dark, its rays graduated. ....137. **eques**.
- nn. *No humeral spot*, upper half of first five developed rays of dorsal black. A. 27-30, scales about 31 .....138. **heteresthes**.
- ll. *Scales 38*. Lower caudal lobe blackish; color of body olive, yellow below. Premaxillary teeth 7 on each side, maxillary teeth numerous, occupying most of the margin of the bone. Head 5 in the length, depth  $4\frac{1}{2}$ ; eye 3 in the head. Anal long, the anterior rays much prolonged, filiform, extending back to the last fifth of the length of the base. D. 10, A. 28. .... 139. **filigerus**.

**133. *Aphyocara pusillis* Günther.**

*Aphyocara pusillis* Günther, Proc. Zool. Soc., 245, 1868 (Huallaga; Xeberos); Cope, Proc. Acad. Nat. Sci. Phila., 260, 1871 (Ambyiacu); *id.* Proc. Am. Philos. Soc., XVII., 689, 1878 (Peruvian Amazon).

*Aphyocara pusillis* Eigenm. & Eigenm., Proc. U. S. Nat. Mus., XIV., 55, 1891.

*Habitat*:—Peruvian Amazon; Huallaga; Xeberos; Ambyiacu.

**134. *Aphyocara alburnus* (Günther).**

*Cheirodon alburnus* Günther, Proc. Zool. Soc., 424, 1869, fig. 2 (Peruvian Amazons).

*Aphyocarax alburnus* Eigenm. & Eigenm., Proc. U. S. Nat. Mus., XIV., 55, 1891.

*Habitat*:—Peruvian Amazon.

135. **Aphyocarax maxillaris** sp. nov.

Maxillary with minute teeth along its entire margin. Intermaxillary with about 10 teeth, the inner 4 three-pointed. Mandible with a few conical teeth in front.

Depth  $3-3\frac{1}{3}$ , head  $3\frac{1}{2}$ , D. 11, A. 22-23, scales 30, tubes 6. Snout very short, the maxillary extending beyond the anterior margin of the eye. Eye about twice the length of snout,  $\frac{3}{7}$  length of head. Origin of dorsal equidistant from tip of snout and base of caudal. Pectorals extend beyond origin of ventrals, the latter to the anal.

A small circular humeral spot, sometimes reduced to two or three color cells. A large black spot on upper half of first dorsal rays, the tips of these rays white. A small black spot near tip of first few anal rays.

It is possible that anal 27 as given for *A. agassizii* is a misprint for A. 23, in which case the present species may prove identical with *A. agassizii* Steindachner.

*Habitat*:—Brazil. Ten specimens 10-11 mm. long.

136. **Aphyocarax agassizii** (Steindachner),

*Cheirodon agassizii* Steind., Flussfische Südamerika's, IV., 38, 1882 (Jatuarana); Eigenm. & Eigenm., Proc. U. S. Nat. Mus. XIV., 54, 1891.

*Habitat*:—Jatuarana.

137. **Aphyocarax eques** (Steindachner)

— *Cheirodon eques* Steind., Flussfische Südamerika's, IV., 37, 1882 (Villa Bella; Obidos).

*Cheirodon eques* Eigenm. & Eigenm., Proc. U. S. Nat. Mus., IV., 54, 1891.

*Habitat*:—Villa Bella; Obidos.

138. **Aphyocarax heteresthes** sp. nov.

Maxillary teeth 6, conical; intermaxillary with 8 conical, and 2 with lateral cusps on each side; mandible 10 conical, 4 with lateral cusps on each side. This species may prove identical with *C. agassizii* or *C. eques* of Steindachner. From the former it differs in having only the upper part of its maxillary dentiferous and apparently in having the anal rays graduated. From the latter it differs in having no humeral spot. Depth 3, head  $3\frac{1}{3}$ , D. 11, A. 27-30, scales about 31. Snout very short, the maxillary long, extending considerably beyond the anterior margin of the eye. Eye twice the length of the snout and  $\frac{2}{7}$  the length of the head.

Origin of dorsal midway between tip of snout and base of caudal. Pectorals extending beyond the tip of the axillary scales of the ventrals, the latter

to the anal. No humeral or caudal spots, the upper half of the first five developed rays of the dorsal black.

*Habitat*:—Brazil. (Six specimens 14–17 mm. in length).

**139. *Aphyocarax filigerus* Cope.**

Proc. Amer. Philos. Soc., 564, 1870 (Pebas); Eigenm. & Eigenm., Proc. U. S. Nat. Mus., XIV., 55, 1891.

*Habitat*:—Pebas.

**140. *Chalceus macrolepidotus* Cuvier.**

Schomburgk, Fish. Brit. Guiana, I., 216, pl. XIV., 1841 (Essequibo); Mem. Mus., IV., 454, pl. 21, fig. 1, Cuv. & Val., XII., 240 1848; Günther, Cat. Fish. Brit. Mus., V., 333, 1864 (Essequibo River; British Guiana; Cupai River) Cope Proc. Acad. Nat. Sci., Phila., 1871, 262 (Ambyiaeu). Eigenm. & Eigenm., Proc. U. S. Nat. Mus., XIV., 55, 1891.

*Brycon macrolepidotus* Müll. & Trosch., Hor. Ichth., I., 15, 1845; *id.* Fische. Brit. Guiana, 635, 1848 (Essequibo; Mazaruni).

*Chalceus ararapeera* Cuv. & Val., XXII., 244, 1848.

Two specimens from Itaituba.

**141. *Chalcinus angulatus* (Spix).**

*Chalceus angulatus* Spix, Pisc. Bras., p. 61, tab. 34, 1829.

*Chalcinus angulatus* Steind., Ichthyol. Beitr., V., 48, 1876 (Santarem; José Fernandez; Iça; Tabatinga; Fonteboa; Villa Bella; Cajaba; Suaguragua; Caçara); *id.* Flussfische, Südamerika's, I., 9, 1879 (Orinoco near Ciudad Bolivar); *id.* Flussfische, Südamerika's, IV., 14, 1882 (Huallaga); Garman, Bull. Essex. Inst., XXII., 3, 1890; Eigenm. & Eigenm., Proc. U. S. Nat. Mus., XIV., 56, 1891.

*Chalcinus brachipomus* Cuv. & Val., XXII., 259; Günther, Cat. Fish. Brit. Mus., V., 341, 1864 (Essequibo).

*Chalceus trifurcatus* Castelnau, Anim. Amer. Sud. Poiss., p. 70, pl. 37, fig. 1, 1855 (Araguay).

*Chalcinus müllerii* De Fil. Rev. et Mag. Zool., 164, 1853.

*Chalcinus nematurus* Kner, Denkschr. Acad. Wiss. Wien, 5, 1858, tab. 1, fig. 1 (not synonym.); Günther, Cat. Fish. Brit. Mus., V., 340, 1864.

*Triportheus flavus* Cope, Proc. Acad. Nat. Sci. Phila., 264, 1872 (Ambyiaeu River).

Seven specimens from Brazil.

These specimens agree with the description and figure of *Chalceus angulatus* of Spix. Steindachner (Beitr., V., 48, 1876) has shown that *Triportheus flavus* Cope is the young of *C. angulatus*, and that Kner's *C. nematurus* = *C. angulatus* Spix.

**142. *Chalcinus elongatus* Günther.**

Cat. Fish. Brit. Mus., V., 342, 1864 (?); Garman, Bull. Essex Inst., 6,

1890 (Teffe; Tocantins; Villa Bella); Eigenm. & Eigenm., Proc. U. S. Nat. Mus., XIV., 56, 1891.

One specimen from Para.

#### HYDROCYONINÆ.

##### 143. **Anacyrtus gibbosus** (Linnaeus).

*Charax* Sp. Gronov. Mus. Ichth., I., 19, 53, tab. 1, fig. 4, 1754; Zoophyl. p. 124, 380.

*Salmo gibbosus* L. Syst. Nat., I., 513, 1866 (Surinam); Bloch & Schn. p. 419, 1801; Schomburgk, F. B. G., 635, 1848 (Lower Essequibo).

*Epieyrtus gibbosus* Müll. & Trosch., Hor. Ichth., I., 17, taf. 2, fig. 1 (dentition) 1845.

*Cynopotamus gibbosus* Cuv. & Val., XXII., 321, pl. 645, 1848; Casteln., Anim. Amer. Sud. Poiss. 75, 1855 (Amazon, Ucayale).

*Anacyrtus gibbosus* Günther, Cat. Fish. Brit. Mus., V., 346, 1864 (Surinam; British Guiana); Eigenm. & Eigenm., Proc. U. S. Nat. Mus., XIV., 57, 1891.

*Epieyrtus macrolepis* Kner. Denkschr. Acad. Wiss. XVIII., 39, taf. 6, fig. 14, 1858 (Rio Guaporé; Cujaba; Caçara; Marabitanos; Surinam).

Marajo, two specimens; Itaituba, two specimens.

##### 144. **Rœboides bicornis** Cope.

Proc. Amer. Philos. Soc., 564, 1870 (Pebas); Eigenm. & Eigenm., Proc. U. S. Nat. Mus., XIV., 57, 1891.

Para (one specimen).

##### 145. **Xiphorhamphus falcistrotris** (Cuv).

*Hydrocyon falcistrotris* Cuv. Mem. Mus. V., 361, pl. 27, fig. 3.

*Xiphorhamphus falcistrotris* Müll. & Trosch., Hor. Ichth., I., 18, 1845 (Brazil); Kner, Denkschr. Acad. Wiss. Wien, XVIII., 58, 1860; Günther, Cat. Fish. Brit. Mus., V., 354, 1864; (Demarara, River Cupai); Günther, Proc. Zool. Soc., 247, 1868 (Xeberos, Pebas); Cope, Proc. Amer. Philos. Soc., XVIII., 688, 1878 (Peruvian Amazon); Steind. Flussfische Südamerika's, IV., 15, 1882 (Hualaga); Eigenm. & Eigenm., Proc. U. S. Nat. Mus., XIV., 58, 1891.

Brazil (five specimens).

##### 146. **Xiphorhamphus falcatus** (Bloch).

*Salmo falcatus* Bloch, taf. 385.

*Xiphorhamphus falcatus* Müll. & Trosch., Hor. Ichth., I., 17, 1845 (Brazil and Guiana); Schomb., Reisen in Brit. Guiana, 635, 1848 (Essequibo and Pomaroon); Kner, Denkschr. Acad. Wiss. Wien, XVIII., 57, 1860 (Caçara, Matto Grosso); Günther, Cat. Fish. Brit. Mus., V., 354, 1864; Eigenm. & Eigenm., Proc. U. S. Nat. Mus., XIV., 58, 1891.

*Xiphorhamphus falcatus* Cuv. & Val., XXII., 337, 1848.

Three specimens from Brazil.

**147. *Xiphystoma ocellatum* Schomburgk.**

Fish. Guiana, I., 145, tab. 23, 1841 (Essequibo, Rio. Negro and Branco); Cuv. & Val., XXII., 355; Kner, Denkschr. Acad. Wiss. Wien, XVIII., 61, taf. 8, fig. 18 (head) 1858 (Rio Branco and Rio Solimoco); Günther, Cat. Fish. Brit. Mus., V., 357, 1864; Eigenm. & Eigenm., Proc. U. S. Nat. Mus., XIV., 59, 1891.

One specimen from Brazil.

**148. *Cynodon gibbus* Spix.**

Pisc. Bras. tab. 27, 1829; Cuv. & Val., XXII., 333, 1848; Castelnau, Anim. Amer. Sud., 75, 1855 (Amazon); Kner, Denkschr. Acad. Wiss. Wien, XVIII., 54, 1858; Günther, Cat. Fish. Brit. Mus., V., 359, 1864; Eigenm. & Eigenm., Proc. U. S. Nat. Mus., XIV., 59, 1891.

*Raphiodon gibbus* Agassiz in Spix, Pisc. Bras, p. 77, 1829.

Trocera on Tocantins (one specimen); Brazil (one specimen).

## SERRASALMONINÆ.

**149. *Mylesinus macropterus* sp. nov.**

Body deep,  $1\frac{2}{3}$  in the length without the caudal; head  $3\frac{1}{2}$  (including the chin in each case). Abdominal serrations 11 behind the ventrals, the posterior 4 in pairs, 22-25 smaller ones before the ventrals. Muzzle once and two-thirds in the orbit which equals the interorbital space. D I. 16, A. 36, V. 7. Scales small, about 83. The lateral line rather deeply curved below the origin of the dorsal. Height of the dorsal fin  $2\frac{2}{3}$  times its length; the second and third rays greatly elongate, the fourth ray about half as long. Anal not lobed. The second and third rays about as long as the base of the fin; the sixth ray about one-fourth as long as the second and third. The ventrals reach the anal, the pectorals nearly to the ventrals. Origin of the dorsal a little nearer the tip of the snout than the base of the caudal. Ventrals beneath the middle of the dorsal.

Snout little more than half as long as the diameter of the eye, the interorbital space a little more than the diameter of the eye. Lower jaw greatly projecting. Teeth in the mandibles in one series, notched and wide apart. Intermaxillaries with two rows of teeth close together, those of the outer row far apart, the inner ones opposite the spaces between two of the outer row.

*Habitat*:—Brazil. (Two specimens 9 cm. long.)

**150. *Pygopristis denticulatus* (Cuvier).**

*Serrasalmo denticulatus* Cuv., Mem. Mus., V., 371; Günther, Cat. Fish. Brit. Mus., V., 367, 1864 (British Guiana).

*Serrasalmo punctatus* Schomb., Fish. Guiana, I., 223, taf. 17, 1841.

*Pygopristis denticulatus* Müll. & Trosch., Hor. Ichth. I., 21, tab. 9, fig. 1, 1845 (young) (Guiana); Schomb., Reisen in Brit. Guiana, 637, 1848 (Essequibo; Rupununi; Takutu); Cuv. & Val., XXII., 297, 1848; Eigenm. & Eigenm., Proc. U. S. Nat. Mus., XIV., 59, 1891.

*Pygopristis fumarius* Müll. & Trosch., l. c. p. 35, tab. 9, fig. 2; Kner, Denkschr. Acad. Wiss. Wien, XVIII., 35, 1858 (Rio Branco).

Ten specimens from the Lower Amazons.

151. **Pygopristis serrulatus** Cuv. & Val.

Cuv. & Val., XXII., 300; Casteln. Anim. Amer. Sud. Poiss., pl. 38, fig. 3, 1855 (Araguay; Amazon); Günther, Cat. Fish. Brit. Mus., V., 367, 1864; Eigenm. & Eigenm., Proc. U. S. Nat. Mus., XIV., 59, 1891.

Brazil (one specimen).

152. **Pygocentrus piraya** (Cuvier).

*Piranha* Maregr. Hist. Nat. Bras., p. 69, 1848.

*Serrasalmo piraya* Cuv. Mem. Mus., V., 368, pl. 28, fig. 4 (bad); Günther, Cat. Fish. Brit. Mus., V., 368, 1864 (Brazil; River Capin; Demerara).

*Pygocentrus piraya* Müll. & Trosch., Hor. Ichth. I., 20 (Brazil, Guiana); Cuv. & Val. XXII., 291; Kner, Denkschr. Acad. Wiss. Wien, XVIII., 36, 1858; Eigenm. & Eigenm., Proc. U. S. Nat. Mus., XIV., 59, 1891.

*Serrasalmo piranha* Spix, Pisc. Bras. p. 71, tab. 28, 1829 (San Francisco River); Schomburgh, Fish Guiana I., 223, pl. XVI., 1841 (Branco).

*Serrasalmo nigricans* Spix, l. c., p. 72, tab. 30 (Young?) (Equatorial rivers of Brazil).

Trocera on Tocantins, one specimen; Brazil, five specimens. In the younger specimens the second infraorbital is separated somewhat from the preopercular limb by a naked strip of skin, while in the older ones it is not thus separated.

153. **Pygocentrus scapularis** (Günther).

*Serrasalmo scapularis* Günther, Cat. Fish. Brit. Mus., V., 368, 1864 (Essequibo River).

*Pygocentrus scapularis* Eigenm. & Eigenm., Proc. U. S. Nat. Mus., XIV., 59, 1891.

Marajo, one specimen.

154. **Serrasalmus marginatus** Valenciennes.

Valenc., in D. Orb. Voy. Amer. Merid. Poiss., pl. 10, fig. 1, 1847; Cuv. & Val., XXII., 277 (Goyaz); Kner, Denkschr. Acad. Wiss. Wien, XVIII., 32, 1858 (Guapore; Cujaba); Günther, Cat. Fish. Brit. Mus., V., 370, 1864; *id.* Ann. & Mag. Nat. Hist., 1880 (La Plata); Eigenm. & Eigenm., Proc. U. S. Nat. Mus., XIV., 60, 1891.

One specimen from Brazil.

155. **Serrasalmus spilopleura** Kner.

*Serrasalmo aureus* Spix, Pisc. Bras., 72, tab. 29, 1829 (Brazil); Cuv. & Val., XXII.; 282, 1848; Castelnau, Anim. Amer. Sud. Poiss., 71, 1855



(Goyaz) ; Kner, Denkschr. Acad. Wiss. Wien, XVIII., 43, 1860 (Montogrosso, Rio Vaupe).

*Serrasalmo spilopleura* Kner, l. c., tab. 5, fig. 11 (Montogrosso ; Rio Guapore ; Bogota) ; Günther, Cat. Fish. Brit. Mus., V., 370, 1864 (River Capin) ; Eigenm. & Eigenm., Proc. U. S. Nat. Mus., XIV., 60, 1891.

*Habitat* :—Tocantins (one specimen) ; Brazil (three specimens).

156. ***Serrasalmus gymnogenys*** Günther.

*Serrasalmus humeralis* Casteln., Anim. Amer. Sud. Poiss. pl. 37, fig. 2, 1855 (Araguay).

*Serrasalmo gymnogenys* Günther, Cat. Fish. Brit. Mus., V., 371, 1864 (River Capin ; British Guiana) ; Eigenm. & Eigenm., Proc. U. S. Nat. Mus., XIX., 60, 1891.

*Habitat* :—Marajo (one specimen).

157. ***Serrasalmus maculatus*** Kner.

Denkschr. Acad. Wiss., Wien, XVIII., 41, taf. 4, fig. 10, 1858 (Matto-grosso, Rio Guaporé) ; Günther, Cat. Fish. Brit. Mus., V., 371, 1864 ; Steind. Flussf. Südamerika's, IV., 16, 1882 (Huallaga) ; Eigenm. & Eigenm., Proc. U. S. Nat. Mus., XIV., 60, 1891.

*Habitat* :—Tocantins. (One specimen).

158. ***Serrasalmus irridopsis*** Cope.

Proc. Acad. Nat. Sci. Phila., 1871, 268, pl. IX., fig. 2 (Ambyiacu) ; Eigenm. & Eigenm., Proc. U. S. Nat. Mus., XIV., 60, 1891.

Tocantins (three specimens). Cope states that this species is peculiar in the number of its abdomino-thoracic dentation, and gives the number of serrations as 41. I find only 31 in two of my specimens as Cope's figure shows. The third specimen is somewhat more slender, the dark edges of the caudal and anal fins are conspicuous, the longitudinal series of round black spots above the lateral line not evident and there are 36 abdominal serrations.

159. ***Serrasalmus brandtii*** Reinhardt.

Lutken, Velhas-Flodens Fiske, XIV., 219, 1875 (Rio das Velhas) ; Eigenm. & Eigenm., Proc. U. S. Nat. Mus., XIV., 60, 1891.

*Habitat* :—Brazil (two specimens).

160. ***Serrasalmus irritans*** Peters.

Monatsb. AK. Wiss. Berlin, 472, 1877 (Fernando de Apure) ; Eigenm. & Eigenm., Proc. U. S. Nat. Mus., XIV., 60, 1891.

*Habitat* :—Marajo, one specimen.

One specimen from the Lower Amazon. D. I., 14; A. 32; V. 7, scales about 95; head,  $3\frac{1}{4}$ ; depth,  $1\frac{5}{7}$ ; abdominal serrations, 35. Palatines with teeth, some indistinct dark spots above the lateral line.

161. ***Myletes rhomboidalis*** Cuvier.

Mem. Mus., IV., 449, pl. 22, fig. 3; Cuv. & Val., XXII., 210, 1848; Casteln., Anim. Amer. Sud. Poiss., 67, 1855 (Amazon); Günther, Cat. Fish. Brit. Mus., V., 373, 1864 (Essequibo); Eigenm. & Eigenm., Proc. U. S. Nat. Mus., XIV., 60, 1891.

*Tetragonopterus latus* Schomb., Fish. Guiana, I., 241, 1841 (Rivers of Guiana).

*Myletes latus* Müll. & Trosch., Hor. Ichth., I., 37, 1845 (Essequibo).

One specimen from Brazil.

162. ***Myletes parma*** Günther.

Cat. Fish. Brit. Mus., V., 374, 1864 (River Capin); Eigenm. & Eigenm., Proc. U. S. Nat. Mus., XIV., 60, 1891.

*Habitat*:—Tocantins, one specimen; Brazil, six specimens.

163. ***Myletes orbignyanus*** Cuv. & Val.

Cuv. & Val., XXII., 220 (Parana); Günther, Cat. Fish. Brit. Mus., V., 375, 1864; Eigenm. & Eigenm., Proc. U. S. Nat. Mus., XIV., 60, 1891.

One specimen from Itaituba. This specimen may be referred with some doubt to *orbignyanus* from Günther's short description of it. I have not access to Cuv. & Val., XXII.

164. ***Myletes hypsauchen*** Müller and Troschell.

Hor. Ichth., I., 38, tab. 10, fig. 1, 1845 (Essequibo; Guiana); Cuv. & Val., XXII., 219; Kner, Denkschr. Acad. Wiss. Wien, XVIII., 26, 1860 (Caicara: Marabitanos); Günther, Cat. Fish. Brit. Mus., V., 376 (Essequibo River); Eigenm. & Eigenm., Proc. U. S. Nat. Mus., XIV., 61, 1891.

*Habitat*:—Tocantins (one specimen); Itaituba (two specimens).

165. ***Myletes oligocanthus*** (Müller and Troschell).

*Myleus oligocanthus* Müll. & Trosch., Hor. Ichth., I., 40, tab. 8, fig. 4 (young), 1845 (Surinam).

*Myletes oligocanthus* Günther, Cat. Fish. Brit. Mus., V., 378, 1864 (Demarara); Eigenm. & Eigenm., Proc. U. S. Nat. Mus., XIV., 61, 1891.

*Habitat*:—Brazil (one specimen).

166. ***Myletes lippencottianus*** Cope.

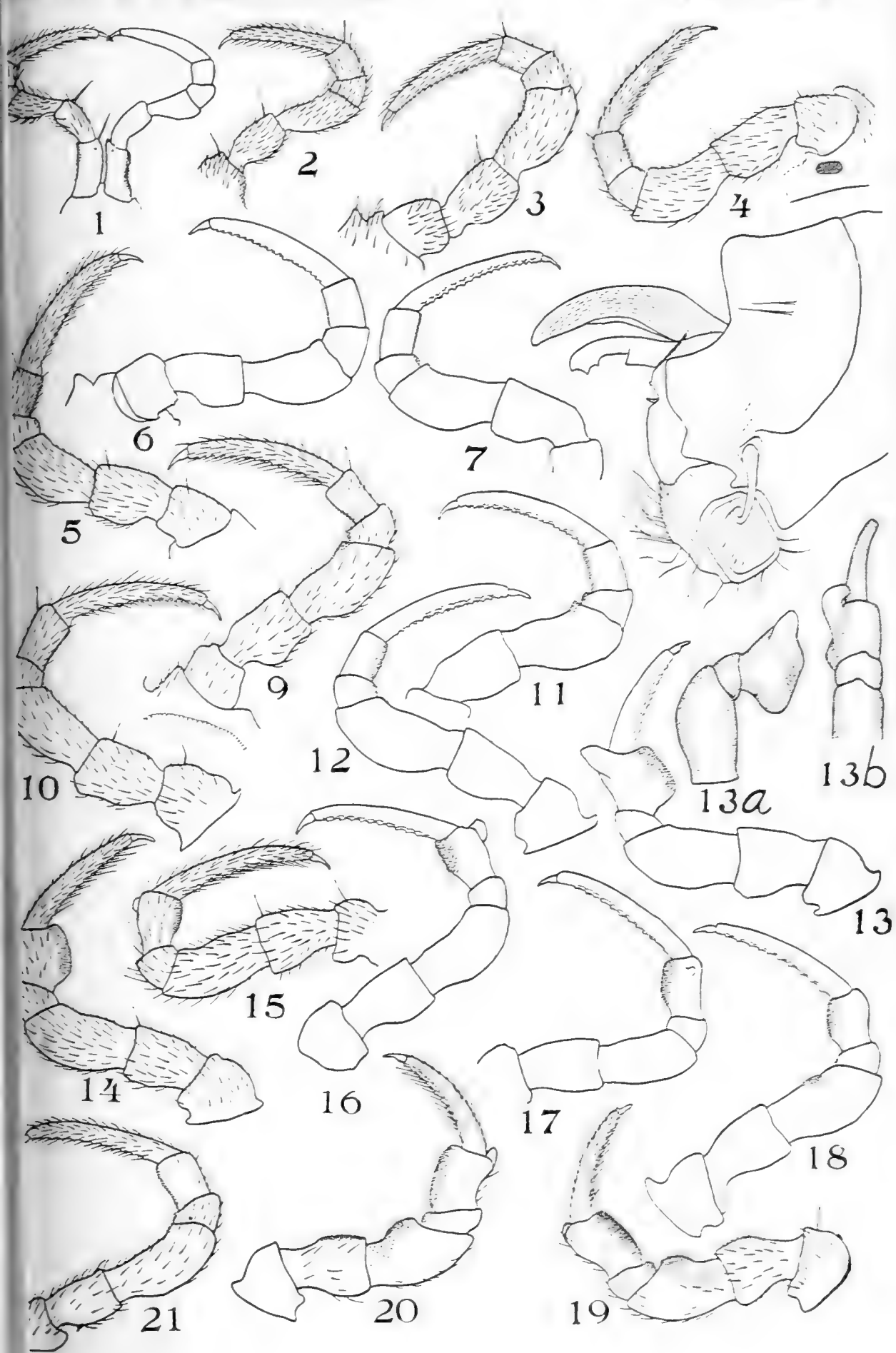
Proc. Amer. Philos. Soc., 561, 1870 (Para, Brazil), Eigenm., Proc. U. S. Nat. Mus., XIV., 61, 1891.

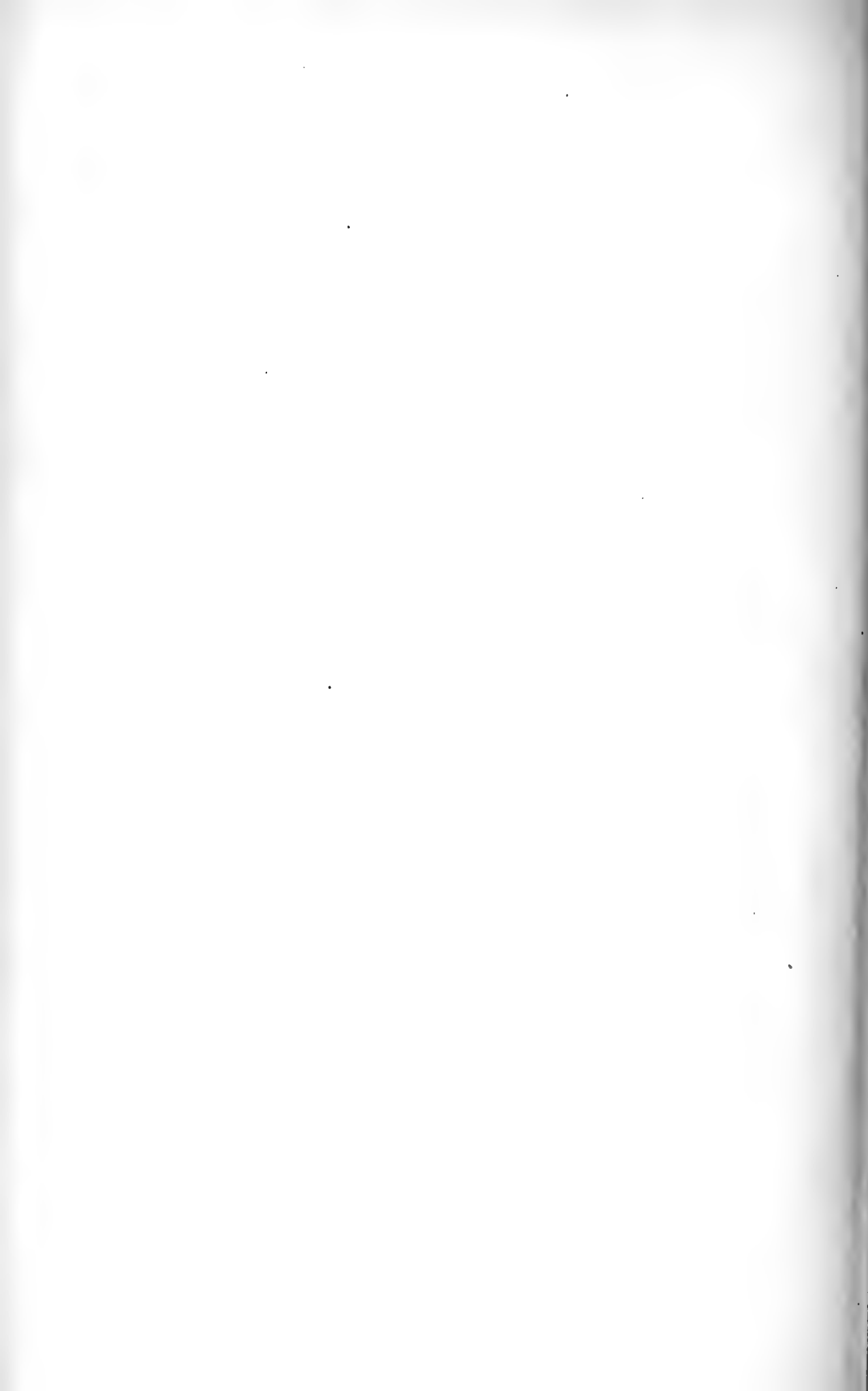
Two specimens from Brazil. The dorsal has a conspicuous black blotch on the upper part of the first rays and the ventrals are dark colored.

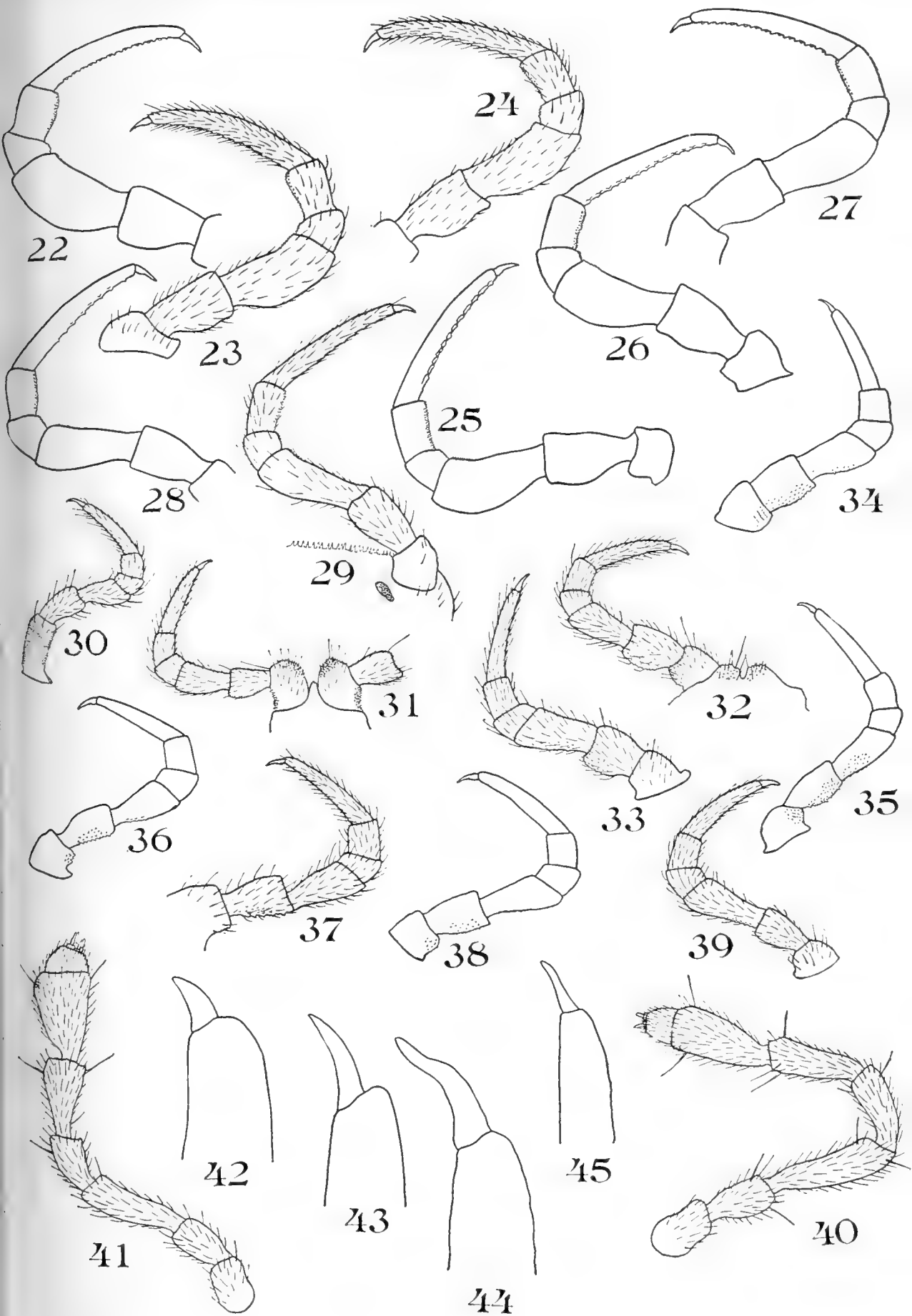
167. ***Myletes nigripinnis*** Cope.

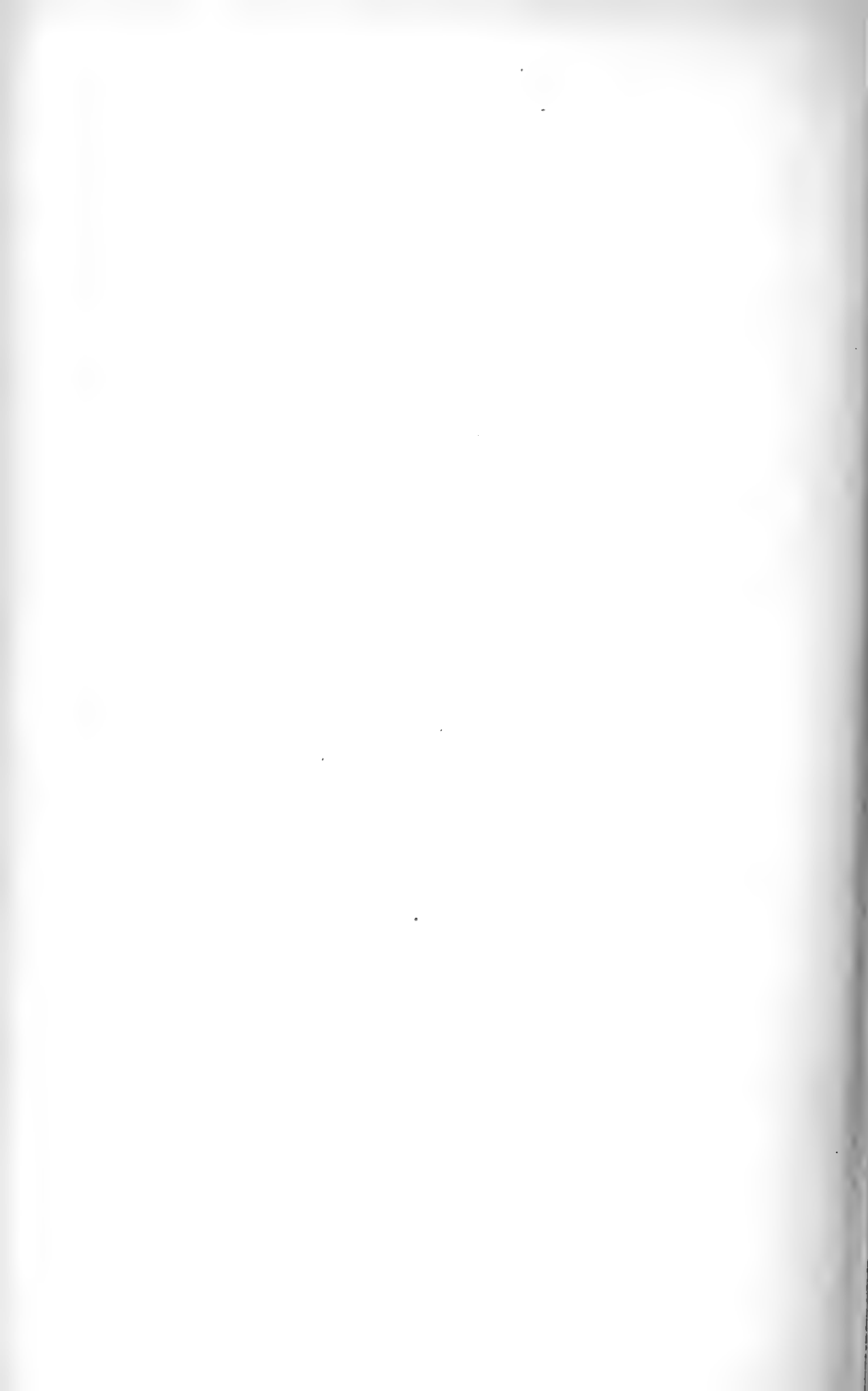
Proc. Amer. Philos. Soc., 693, 1878 (Peruvian Amazon); Eigenm. & Eigenm., Proc. U. S. Nat. Mus., XIV., 61, 1891.

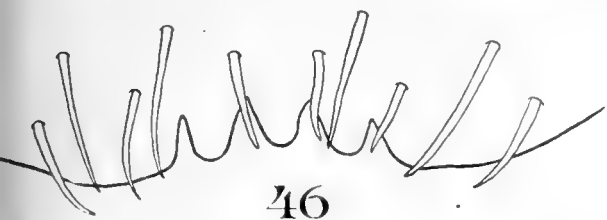
One specimen, 34 cm. long from Brazil. The depth is half the length *without* the caudal, head  $3\frac{1}{2}$  with the caudal as in Cope's specimens. D. 18; A. 25; V. 8; P. 16; inferior paired fins not very short, the first dorsal ray considerably behind the base of the ventrals and the anal behind the dorsal. The orbit is contained in the head more than five times, the labial beards quite prominent. Opercle twice as high as long, abdominal serrations fifty.



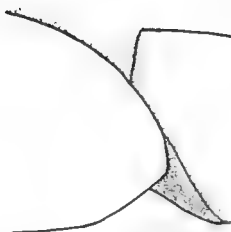




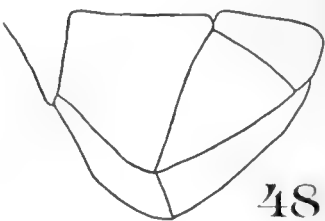




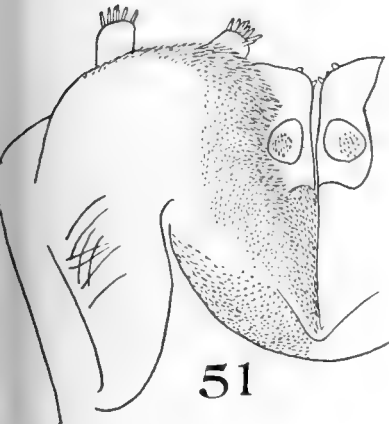
46



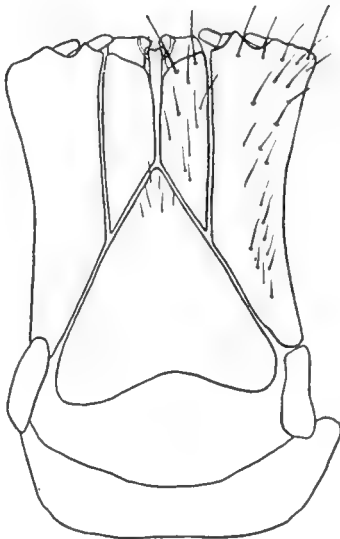
47



48



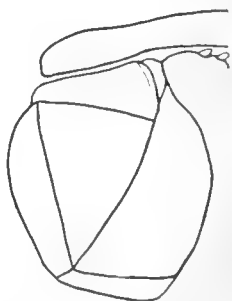
51



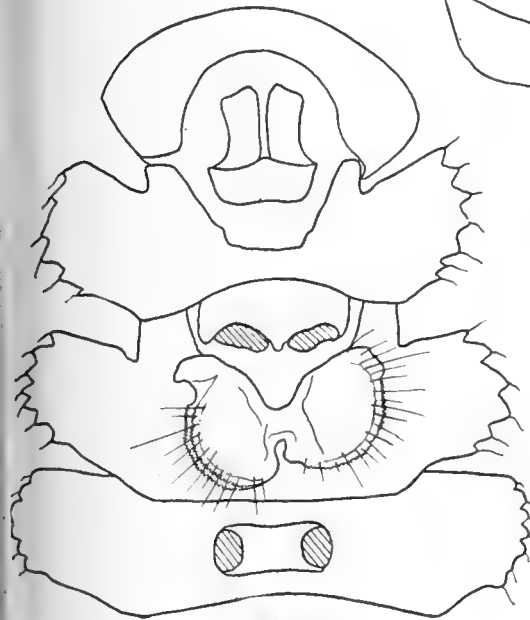
50



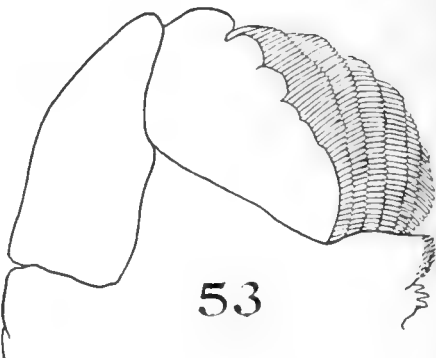
52



49



54



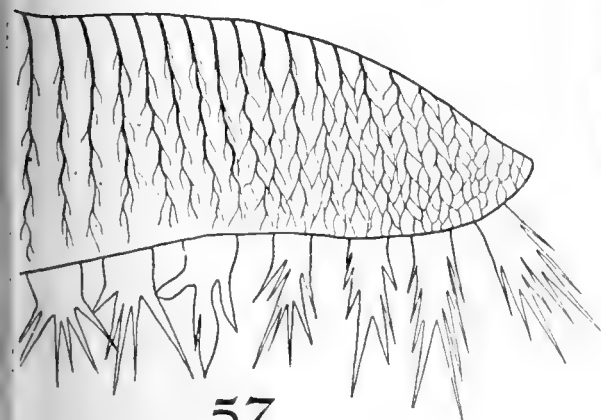
53



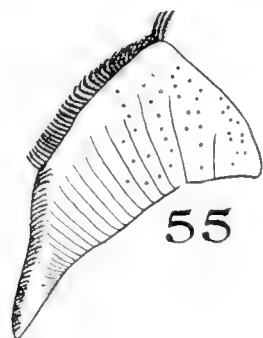
56



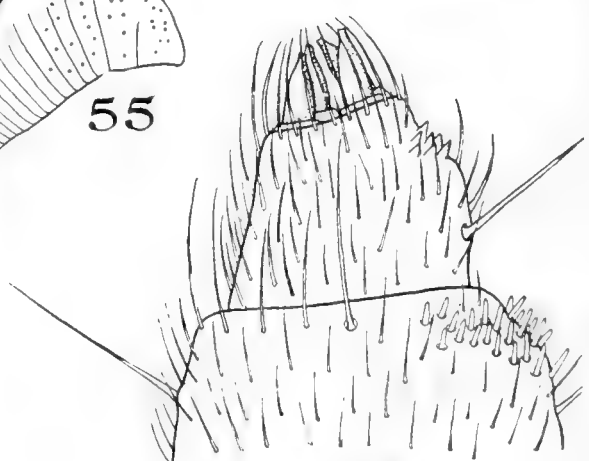
58



57



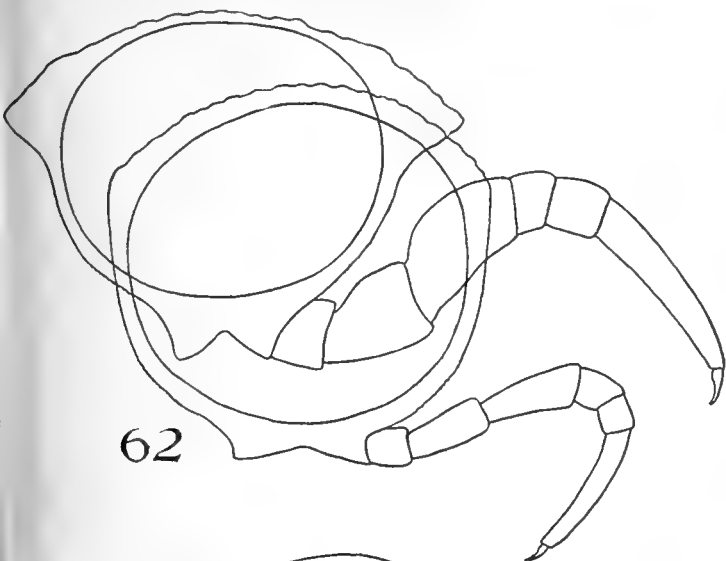
55



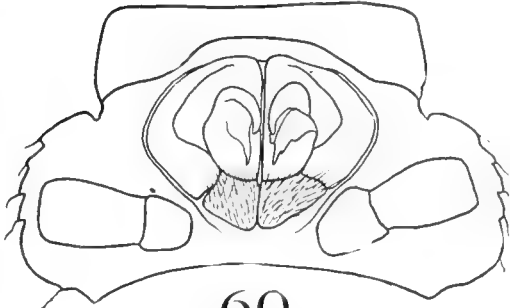
59



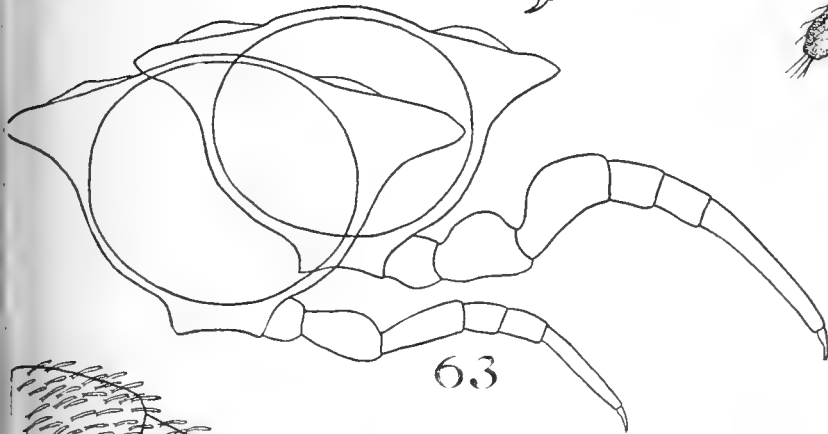




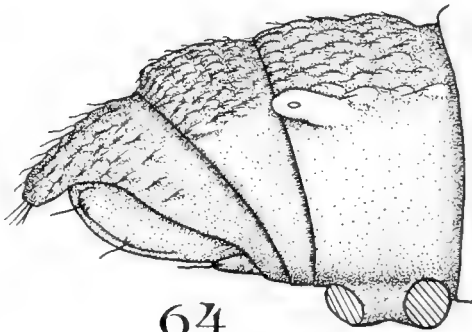
62



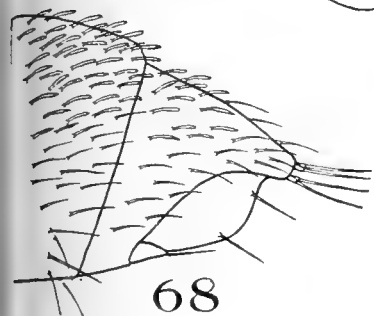
60



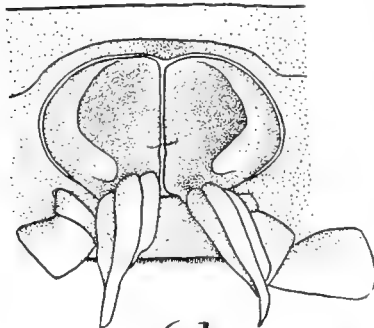
63



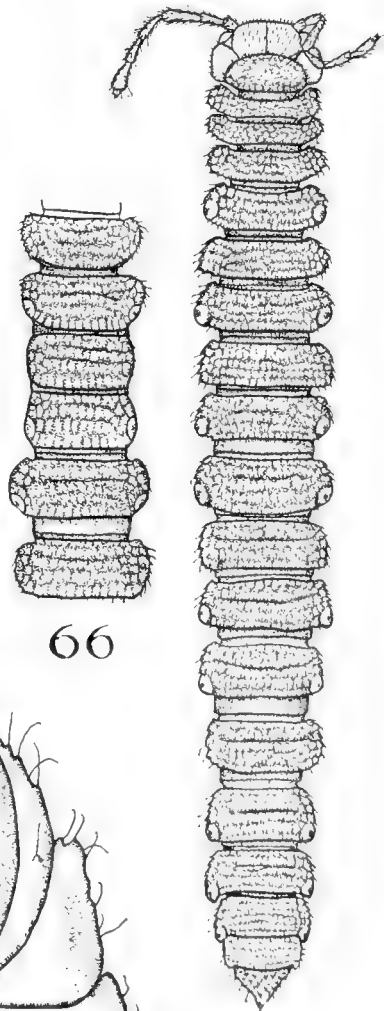
64



68



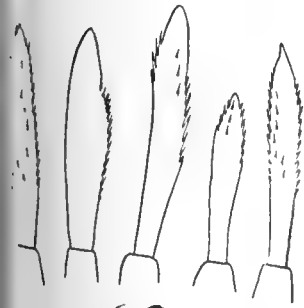
61



65



66



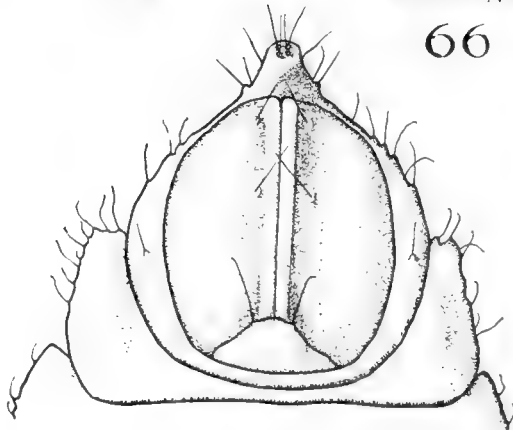
69



71



70



67



# ANNALS

## OF THE

### NEW YORK ACADEMY OF SCIENCES.

---

The "ANNALS," published for over half a century by the Lyceum of Natural History, are continued under the above name by the New York Academy of Sciences, beginning in 1877. Six volumes of the new series have now been issued.

With the beginning of the fourth volume, the Academy decided to change somewhat the mode of publication. The ANNALS are henceforth issued without particular reference to times or periods. The parts will appear as material for them shall be offered; each single part, or number, as before, will contain at least 32 pages, with or without plates; twelve numbers, as before, whenever published, will constitute a volume. The size and general character of the parts and volumes will not be changed; nor is it intended at all to reduce the average yearly amount of matter.

The ANNALS include the more extended and elaborate papers laid before the Academy. The briefer papers and discussions that form part of the Academy's meetings appear in its other publication, the TRANSACTIONS, which it is designed to issue promptly and regularly, so as to give a record of the current work of each year,—the single numbers appearing monthly (or double, bi-monthly), and eight single numbers forming an annual volume.

By vote of the Academy, both these publications will be sent FREE to its Resident and Honorary members. To non-resident members the price of the TRANSACTIONS will be \$3.00 per year.

To all others, prices will be as follows:

|  |              |
|--|--------------|
| Annals, single numbers, . . . . .            | Fifty cents. |
| " double or multiple numbers, in proportion. |              |
| " per volume (12 numbers), . . . . .         | Six Dollars. |

|                                   |               |
|-----------------------------------|---------------|
| Transactions, per year, . . . . . | Five Dollars. |
| " single numbers, . . . . .       | Fifty Cents.  |

All communications should be addressed to

THOS. L. CASEY,  
*Norfolk, Va.*

Or to

J. F. KEMP,  
*Columbia College, New York.*

The Academy has for sale a number of back volumes of the ANNALS of both series, each containing twelve or more numbers; the price per volume is Five Dollars in the old (Lyceum) series, and Six Dollars in the new (Academy) series.

## CONTENTS.

|  | PAGE |
|--|------|
| VIII.—A Monograph of <i>Seytonotus</i> . By O. F. COOK and A. C. COOK . . . . .                      | 233  |
| IX.—The South American Cat-fishes Belonging to Cornell University. By EDWARD M. KINDLE . . . . .     | 249  |
| X.—The South American Characinidæ Collected by Charles Frederick Hartt. By ALBERT B. ULREY . . . . . | 257  |

Vol. VIII.

November, 1895.

Nos. 6-12.

ANNALS  
OF THE  
NEW YORK ACADEMY OF SCIENCES,  
LATE  
LYCEUM OF NATURAL HISTORY.



New York:  
PUBLISHED BY THE ACADEMY.  
1895.

OFFICERS OF THE ACADEMY,  
1895-96.

---

President.

J. K. REES.

Vice-Presidents.

H. F. OSBORN,

J. J. STEVENSON.

Corresponding Secretary.

D. S. MARTIN.

Recording Secretary.

J. F. KEMP.

Treasurer.

CHAS. F. COX.

Committee of Publication.

J. K. REES,

J. F. KEMP,

H. F. OSBORN,

N. L. BRITTON,

D. S. MARTIN,

WILLIAM HALLOCK.

THOS. L. CASEY (EDITOR OF ANNALS).

# XI.—*The Parallax of $\eta$ Cassiopeiæ, deduced from Rutherford Photographic Measures.*

BY HERMAN S. DAVIS.

Read Feb. 4, 1895.

Between July 30, 1870, and December 21, 1873, twenty-seven negatives of the stars about  $\eta$  Cassiopeiæ were taken by RUTHERFURD. The conditions of exposure and, indeed, even the dates, as well as also the methods of measurement and of reduction are almost identical with those of  $\mu$  and  $\theta$  Cassiopeiæ already reduced for parallax.\* Hence reference to that paper will make clear the plan followed in the application of corrections for division errors, the "tangent correction," for refraction and for aberration.

The observations have been reduced to the epoch 1872.0, using AUWERS' proper motion which is

$$\Delta\alpha = + 0^s.1346 \qquad \Delta\delta = - 0.''481,$$

corresponding to a motion of  $1.''1965$  on a great circle whose position angle is  $113^\circ 42' 10''$ . Representing this motion by  $\rho$  (expressed in terms of one division of the glass scale as a unit of measure =  $0^d.042712$ ) and the angle by  $\chi$  at the time 1872.0, the time of observation by  $t$ , the position angle of the star relative to  $\eta$  Cassiopeiæ by  $p$  and its distance by  $s$  after the corrections named in the first paragraph have been applied, we compute†

$$\tau = t - 1872.$$

$$S_1 = \cos (\chi - p)$$

$$S_2 = - \frac{1}{2s} \sin^2 (\chi - p)$$

$$P_1 = \tau\rho$$

$$P_2 = \tau^2\rho^2$$

\*The Parallaxes of  $\mu$  and  $\theta$  Cassiopeiæ, deduced from Rutherford Photographic Measures. By Harold Jacoby. *Annals N. Y. Acad. Sci.*, Vol. VIII., p. 1.

†*Ibid.*, p. 3.



The numerical values of these quantities as applicable to the present purpose are given in Table III., pages 308-9, and the correction for proper motion is

$$S_1 P_1 + S_2 P_2$$

to be added to the observed distance  $s$ .

The distances thus completely corrected are to be found in the second and third columns of Table IV., pages 310-15. The fourth and fifth columns respectively of the same table contain the *sum* of the distances of the two comparison stars from  $\gamma$  Cassiopeiæ and the difference of that sum from the mean given at the foot of the fourth column. In the sixth, seventh, and eighth columns are placed the *difference* of the distances as given in the second and third columns; the *scale correction*, which is simply a proportional part of the quantity given in the column "mean minus sum;" and finally the *corrected difference* to be used in forming the parallax equations. The latter equations, together with their solutions, are in Table V., pages 316-21, where the absolute terms are expressed in units of the second decimal place equivalent to 0."2801 as the value of one division of the glass scale.

Using AUWERS' values of the coördinates of  $\gamma$  Cassiopeiæ reduced to 1872.0

$$\alpha = 0^h 41^m 22.^s 108$$

$$\delta = 57^\circ 8' 10.'' 50$$

and the almanac values of  $r$  and  $\odot$ , the radius vector and longitude of the sun respectively, the values of  $S_3$ ,  $S_4$ ,  $P_3$  and  $P_4$  were computed by the formulæ\*

$$\begin{aligned} g \sin G &= \sin \delta \cos \alpha & h \sin H &= \sin \delta \sin \alpha \\ g \cos G &= \sin \alpha & h \cos H &= -\cos \delta \end{aligned}$$

$$f \sin F = h \sin (H + \varepsilon)$$

$$f \cos F = -\cos \alpha \cos \varepsilon$$

$$S_3 = f \sin (p + F)$$

$$S_4 = g \sin (p + G)$$

$$P_3 = -r \sin \odot$$

$$P_4 = -r \cos \odot$$

\*Annals N. Y. Acad. Sci., Vol. VIII., p. 4.

The resulting values for the separate stars and plates are given in Table III., pages 308-9. From them we derive as the parallax coefficient for any one of the equations of Table V.

$$(S_3 - S'_3) P_3 + (S_4 - S'_4) P_4$$

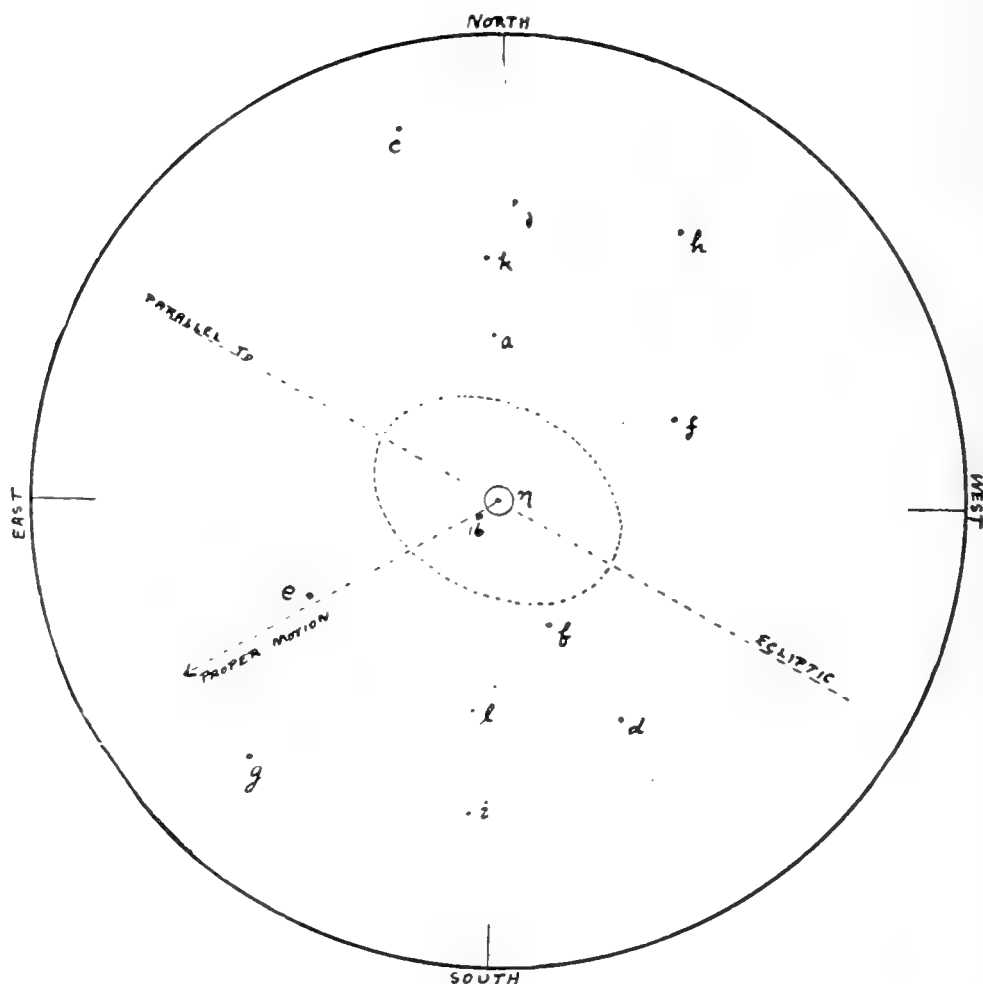
where  $S'_3$  and  $S'_4$  refer always to the *less distant* comparison star of the pair.

It seemed to me desirable, in view of the exceedingly great difficulty of getting comparison stars suitably situated either with respect to position angle or distance, to take a larger number than usual, and I have consequently reduced six pairs, being *all* that were impressed on the plates sufficiently often in both seasons of the year, and the present paper includes all six, though only three of them are so situated with reference to the parallactic ellipse as to give good coefficients for  $\pi$ . Every observation and every plate was used.

In Table II., page 308, will be found the approximate positions of these stars relative to the central star which the accompanying diagram also represents graphically, and shows in addition the direction of the axes of the parallactic ellipse and of the proper motion of  $\eta$  Cassiopeiæ.

It should be stated, however, that the circle does not represent the limits of the field of view, nor are the distances given on the same scale as those of the plates at the focus of the telescope; the diagram is intended to give only roughly the *relative* location of the stars used in this investigation. It will be noticed how the N. E. quadrant is inconveniently void of stars bright enough to be impressed on the plates at all seasons of the year.

The star designated as No. 16 was so numbered by RUTHERFURD on the plates when measured, but is the same star as No. 45, in order of right ascension, referred to on page 305.



The results are :

| Comp. Stars.          | $\pi$              | Weight. | $\eta$             | Prob. error<br>one equation. |
|-----------------------|--------------------|---------|--------------------|------------------------------|
| <i>a</i> and <i>b</i> | $+0.349 \pm 0.086$ | 21.7800 | $+0.260 \pm 0.081$ | $\pm 0.403$                  |
| <i>c</i> and <i>d</i> | $+0.385 \pm 0.084$ | 28.9724 | $+0.165 \pm 0.085$ | $\pm 0.362$                  |
| <i>e</i> and <i>f</i> | $+0.568 \pm 0.056$ | 29.6264 | $+0.378 \pm 0.078$ | $\pm 0.305$                  |
| <i>g</i> and <i>h</i> | $+0.662 \pm 0.078$ | 8.2443  | $+0.232 \pm 0.049$ | $\pm 0.2740$                 |
| <i>i</i> and <i>j</i> | $+0.660 \pm 0.138$ | 6.1457  | $-0.111 \pm 0.066$ | $\pm 0.342$                  |
| <i>k</i> and <i>l</i> | $+0.297 \pm 0.155$ | 6.1365  | $-0.070 \pm 0.073$ | $\pm 0.384$                  |

From these we get as the value of the parallax of  $\eta$  Cassiopeiæ

$$\begin{aligned} \pi &= + 0.443 \pm 0.043 \quad \text{using the first three pairs only} \\ \text{or} \quad &= + 0.465 \pm 0.044 \quad \text{using all six pairs.} \end{aligned}$$

It would be quite unsafe to conclude that the small result derived from the stars *k* and *l* is due to a parallax of one or other

of these two; yet it may not be amiss to state that if we combine, to form a comparison pair,

$l$  with  $a$  we get  $\pi = + 0.282 \pm 0.197$  weight 5.1956 p. e. one equation  $\pm 0.4492$   
 $i$  with  $k$   $\pi = + 0.359 \pm 0.124$  8.0319  $\pm 0.3516$

Results by other observers for the parallax of  $\eta$  Cassiopeiæ are :

O. Struve\*  $\pi = + 0.373 \pm 0.098$  by measures of position angle  
 $= + 0.096 \pm 0.051$  " " " distance  
 concluded mean  $+ 0.154 \pm 0.045$

Schweizer† and Socoloff  $\pi = + 0.1386 \pm 0.0849$  by measures of position angle  
 $= + 0.3743 \pm 0.0723$  " " " distance  
 concluded mean  $+ 0.2750 \pm 0.0551$

STRUVE is not explicit in his statement, but the evidence seems to be that his comparison star was the same as that used by SCHWEIZER, namely, No. 45 on these plates, and whose position, as given by the RUTHERFURD measures,‡ is

$$\begin{aligned} \alpha &= 0^h 41^m 49.555 \\ \delta &= 57^\circ 6' 8.87 \end{aligned}$$

reduced from twelve plates whose mean epoch is 1873.016 referred to  $\eta$  Cassiopeiæ at the epoch 1872.0 assuming its coördinates at that date to be as given on page 302. This is DM.  $57^\circ 15.5$ .

From the values of  $y$  obtained in the solution of the normal equations a correction for the assumed proper motion of  $\eta$  Cassiopeiæ may be computed from equations of the form§

$$(\cos p - \cos p') w + (\sin p - \sin p') v - y = 0$$

where  $w$  = the correction required by the adopted value of  $\rho \cos \chi$   
 $v$  = " " " " "  $\rho \sin \chi$

and  $p, p'$  = the position angle of the comparison stars, the primed letter referring always to the *less distant* of the two.

\* Bulletin Physico-Mathématique de l'Académie de Saint-Pétersbourg, vol. xiv., p. 228, published 1855.

† Annales de l'Observatoire de Moscou, vol. viii., part 2, p. 89, published 1882.

‡ The Rutherford Photographic Measures of Sixty-two Stars about  $\eta$  Cassiopeiæ. By Herman S. Davis. Contrib. from the Observ. of Columbia College, No. 7.

§ Annals N. Y. Acad. Sci.; Vol. VIII., p. 10.

The equations thus obtained are :

$$\begin{array}{rclcl}
 \text{Stars } a, b & + & 1.9146 & w & + 0.4593 & v & - 0.2598 & = & 0 \\
 c, d & + & 1.8232 & & + 0.7773 & & - 0.1653 & = & 0 \\
 e, f & - & 0.8337 & & + 0.8176 & & - 0.3781 & = & 0 \\
 g, h & - & 1.5436 & & + 1.2615 & & - 0.2318 & = & 0 \\
 i, j & - & 1.9961 & & + 0.1171 & & + 0.1113 & = & 0 \\
 k, l & + & 1.9950 & & - 0.0461 & & + 0.0698 & = & 0
 \end{array}$$

from which the normal equations are :

$$\begin{array}{rcl}
 + 18.0319 & w & - 1.4917 & v & - 0.2087 & = & 0 \\
 & & + 5.7260 & & - 1.2176 & = & 0
 \end{array}$$

and the solution gives :

$$w = + 0.''0298 \pm 0.''0147$$

$$v = + 0.2204 \pm 0.0264$$

$$\text{the probable error of one equation} = \pm 0.''0624$$

Applying these corrections to the values previously assumed,

$$\text{Corrected } \rho \sin \chi = + 1.''3160 = \Delta a \cos \delta$$

$$\text{" } \rho \cos \chi = - 0.4512 = \Delta \delta$$

$$\text{which gives } \Delta a = + 0^s.1617 \quad \Delta \delta = - 0.''4512$$

corresponding to a motion of  $1.''3912$  on a great circle whose position angle is  $108^\circ 55' 30''$ .

Considering the difficulties that beset the investigation of the parallax of this star, and the probability that all previous determinations have been made with a single comparison star, which may itself have a parallax; considering also the large differences exhibited by the separate results of other observers, it would seem that the result here given is not impossibly large, if the RUTHERFURD plates are subject to no systematic error. Whether such error exist or not, these plates of  $\eta$  Cassiopeiae seem at any rate entirely unsuited for an investigation of it, and I have therefore in the preparation of this paper confined myself strictly to the methods and formulæ and often even to the phraseology of Professor Jacoby in his paper on  $\mu$  and  $\theta$  Cassiopeiae, already several times referred to, since this is but one in a series of many papers to be produced from the Rutherford measures, and since in such a series uniformity is desirable.

A catalogue of all the stars (62) on these plates has been reserved for a separate paper which will be published soon, as No. 7 of *Contributions from the Observatory of Columbia College*.

TABLE I.—GENERAL DATA.

OBSERVATORY OF L. M. RUTHERFURD, NEW YORK.

Lat. =  $40^{\circ} 43' 48''.5$ . Long. =  $4^{\text{h}} 55^{\text{m}} 56^{\text{s}}.62$  W.

| Plate No. | Date.        | Sidereal Time.                                  | Hour Angle.                                     | Zen. Dist. | Parall. Angle. | Ext. Temp. | Focal Mic'r. |
|-----------|--------------|---|---|------------|----------------|------------|--------------|
| 1         | 1870 July 30 | 21 <sup>h</sup> 32 <sup>m</sup> 15 <sup>s</sup> | 20 <sup>h</sup> 50 <sup>m</sup> 53 <sup>s</sup> | 34.20      | — 97.95        | 70         | 7.9          |
| 2         | 1870 July 30 | 22 7 30   | 21 26 8   | 29 55      | — 107.02       | 70         | 7.9          |
| 3         | 1870 Aug. 4  | 23 53 55  | 23 12 33  | 18.11      | — 149.92       | 70         | 7.9          |
| 4         | 1870 Aug. 4  | 23 7 50   | 22 26 28  | 22.26      | — 127.44       | 70         | 7.9          |
| 5         | 1871 July 17 | 20 2 20   | 19 20 58  | 46.34      | — 79.34        | 72         | 8.0          |
| 6         | 1871 July 17 | 20 54 35  | 20 13 13  | 39.30      | — 89.58        | 72         | 8.0          |
| 7         | 1871 Dec. 15 | 4 44 45   | 4 3 23  | 41.55      | + 86.20        | 23         | 8.0          |
| 8         | 1872 Jan. 2  | 1 44 15   | 1 2 53  | 19.71      | + 141.56       | 34         | 7.9          |
| 9         | 1872 Jan. 2  | 2 23 40   | 1 42 18   | 23.23      | + 123.93       | 34         | 7.9          |
| 10        | 1872 Jan. 5  | 3 34 35   | 2 53 13   | 32.10      | + 101.87       | 35         | 7.9          |
| 11        | 1872 June 30 | 20 42 38  | 20 1 16   | 40.90      | — 87.14        | 78         | 7.1          |
| 12        | 1872 June 30 | 21 13 28  | 20 32 6   | 36.74      | — 93.65        | 78         | 7.1          |
| 13        | 1872 July 19 | 19 32 52  | 18 51 30  | 50.24      | — 73.98        | 71         | 7.29         |
| 14        | 1872 July 19 | 20 9 28   | 19 28 6   | 45.38      | — 80.67        | 71         | 7.29         |
| 15        | 1873 Jan. 9  | 3 38 48   | 2 57 26   | 32.64      | — 100.81       | 24         | 7.8          |
| 16        | 1873 Jan. 10 | 2 18 2  | 1 36 40   | 22.60      | — 126.17       | 21         | 7.95         |
| 17        | 1873 Jan. 10 | 2 49 58   | 2 8 36  | 26.34      | — 114.64       | 21         | 7.95         |
| 18        | 1873 July 15 | 19 51 58  | 19 10 36  | 47.72      | — 77.43        | 75         | 7.75         |
| 19        | 1873 July 15 | 20 21 18  | 19 39 56  | 43.79      | — 82.93        | 75         | 7.75         |
| 20        | 1873 July 20 | 19 23 18  | 18 41 56  | 51.48      | — 72.27        | 69         | 7.8          |
| 21        | 1873 July 20 | 19 59 32  | 19 18 10  | 46.71      | — 78.82        | 69         | 7.8          |
| 22        | 1873 July 21 | 19 31 32  | 18 50 10  | 50.42      | — 73.75        | 69         | 7.8          |
| 23        | 1873 Dec. 15 | 1 43 8  | 1 1 46  | 19.20      | + 142.14       | 40         | 7.8          |
| 24        | 1873 Dec. 15 | 2 23 32   | 1 42 10   | 23.21      | + 123.99       | 40         | 7.8          |
| 25        | 1873 Dec. 18 | 2 54 2  | 2 12 40   | 26.85      | + 113.34       | 41         | 7.8          |
| 26        | 1873 Dec. 18 | 3 38 48   | 2 57 26   | 32.64      | + 100.81       | 41         | 7.8          |
| 27        | 1873 Dec. 21 | 2 4 32  | 1 23 10   | 21.18      | + 131.87       | 27         | 7.9          |

TABLE II.—COMPARISON STARS.

| Designation<br>of Comp.<br>Star. | No. in<br>A. G. Cat.<br>Helsingfors-<br>Gotha. | Mag. in<br>A. G. Cat. | Approx. Position Referred to $\gamma$ Cass. |                 |
|----------------------------------|--|-----------------------|---|-----------------|
|                                  |  |                       | Distance.                                   | Position Angle. |
| <i>a</i>                         | 658  | 8.9                   | 1316''                                      | 3° 23'          |
| <i>b</i>                         | 639  | 8.8                   | 1148  | 203 36          |
| <i>c</i>                         | 687  | 8.2                   | 3416  | 15 24           |
| <i>d</i>                         | 621  | 8.8                   | 2100  | 210 47          |
| <i>e</i>                         | 713  | 9.0                   | 1820  | 113 34          |
| <i>f</i>                         | 609  | 8.4                   | 1708  | 295 43          |
| <i>g</i>                         | 730  | 7.5                   | 3052  | 136 10          |
| <i>h</i>                         | 607  | 9.0                   | 2828  | 325 19          |
| <i>i</i>                         | 665  | 7.1                   | 2744  | 175 18          |
| <i>j</i>                         | 649  | 8.8                   | 2604  | 357 59          |
| <i>k</i>                         | 659  | 8.8                   | 2156  | 2 53            |
| <i>l</i>                         | 663  | 8.3                   | 1848  | 174 28          |

TABLE III.—PROPER MOTION AND PARALLAX.

| Star.    | Proper Motion. |         | Parallax. |         |
|----------|----------------|---------|-----------|---------|
|          | $S_1$ .        | $S_2$ . | $S_3$ .   | $S_4$ . |
| <i>a</i> | —0.347         | —0.009  | —0.1307   | +0.8356 |
| <i>b</i> | +0.002         | —0.012  | +0.4324   | —0.8290 |
| <i>c</i> | —0.144         | —0.004  | —0.3145   | +0.8443 |
| <i>d</i> | —0.123         | —0.007  | +0.5285   | —0.8019 |
| <i>e</i> | +1.000         | 0.000   | —0.7962   | —0.1660 |
| <i>f</i> | —0.999         | 0.000   | +0.7793   | +0.1969 |
| <i>g</i> | +0.924         | —0.001  | —0.5690   | —0.4719 |
| <i>h</i> | —0.852         | —0.001  | +0.4496   | +0.5775 |
| <i>i</i> | +0.476         | —0.004  | +0.0034   | —0.8089 |
| <i>j</i> | —0.434         | —0.004  | —0.0458   | —0.8196 |
| <i>k</i> | —0.355         | —0.006  | —0.1229   | +0.8345 |
| <i>l</i> | +0.488         | —0.006  | —0.0097   | —0.8052 |

TABLE III (*continued*).—PROPER MOTION AND PARALLAX.

| Plate<br>No. | $t-1872.$ | Proper Motion. |         | Parallax. |         |
|--------------|-----------|----------------|---------|-----------|---------|
|              |           | $P_1.$         | $P_2.$  | $P_3.$    | $P_4.$  |
| 1            | —1.420    | —0.0606        | +0.0037 | —0.8024   | +0.6213 |
| 2            | —1.420    | —0.0606        | +0.0037 | —0.8024   | +0.6213 |
| 3            | —1.406    | —0.0600        | +0.0036 | —0.7485   | +0.6843 |
| 4            | —1.406    | —0.0600        | +0.0036 | —0.7485   | +0.6843 |
| 5            | —0.455    | —0.0195        | +0.0004 | —0.9210   | +0.4295 |
| 6            | —0.455    | —0.0195        | +0.0004 | —0.9210   | +0.4295 |
| 7            | —0.043    | —0.0018        | 0.0000  | +0.9783   | +0.1054 |
| 8            | +0.006    | +0.0002        | 0.0000  | —0.9610   | —0.2078 |
| 9            | +0.006    | +0.0002        | 0.0000  | +0.9610   | —0.2078 |
| 10           | +0.014    | +0.0006        | 0.0000  | +0.9487   | —0.2586 |
| 11           | +0.501    | +0.0214        | +0.0005 | —1.0025   | +0.1696 |
| 12           | +0.501    | +0.0214        | +0.0005 | —1.0025   | +0.1696 |
| 13           | +0.553    | +0.0236        | +0.0006 | —0.8994   | +0.4725 |
| 14           | +0.553    | +0.0236        | +0.0006 | —0.8994   | +0.4725 |
| 15           | +1.025    | +0.0438        | +0.0019 | +0.9235   | —0.3380 |
| 16           | +1.028    | +0.0439        | +0.0019 | +0.9173   | —0.3546 |
| 17           | +1.028    | +0.0439        | +0.0019 | +0.9173   | —0.3546 |
| 18           | +1.539    | +0.0657        | +0.0043 | —0.9308   | —0.4080 |
| 19           | +1.539    | +0.0657        | +0.0043 | —0.9308   | —0.4080 |
| 20           | +1.553    | +0.0663        | +0.0044 | —0.8920   | +0.4863 |
| 21           | +1.553    | +0.0663        | +0.0044 | —0.8920   | +0.4863 |
| 22           | +1.556    | +0.0664        | +0.0044 | —0.8850   | —0.4987 |
| 23           | +1.956    | +0.0836        | +0.0070 | +0.9792   | —0.0966 |
| 24           | +1.956    | +0.0836        | +0.0070 | +0.9792   | —0.0966 |
| 25           | +1.965    | +0.0839        | +0.0070 | +0.9827   | —0.0441 |
| 26           | +1.965    | +0.0839        | +0.0070 | +0.9827   | —0.0441 |
| 27           | +1.973    | +0.0843        | +0.0071 | +0.9835   | —0.0083 |



TABLE IV.—OBSERVATIONAL DATA.

COMPARISON STARS *a* AND *b*.

| Plate<br>No. | Corrected Distance. |                 | Sum<br><i>a</i> + <i>b</i> . | Mean<br><i>Minus</i> Sum | Difference<br><i>a</i> — <i>b</i> . | Scale Corr. | Corrected<br>Difference. |
|--------------|---------------------|-----------------|------------------------------|--------------------------|-------------------------------------|-------------|--------------------------|
|              | Star <i>a</i> .     | Star <i>b</i> . |                              |                          |                                     |             |                          |
| 1            | 47.2431             | 40.7833         | 88.0264                      | — .0084                  | 6.4598                              | — .0017     | 6.4581                   |
| 4            | .2506               | .7693           | 88.0199                      | — .0019                  | .4813                               | — .0004     | .4809                    |
| 5            | .2522               | .7816           | 88.0338                      | — .0158                  | .4706                               | — .0032     | .4674                    |
| 6            | .2382               | .7841           | 88.0223                      | — .0043                  | .4541                               | — .0009     | .4532                    |
| 7            | .2620               | .7327           | 87.9947                      | + .0233                  | .5293                               | + .0047     | .5340                    |
| 8            | .2514               | .7583           | 88.0097                      | + .0083                  | .4931                               | + .0017     | .4948                    |
| 10           | .2541               | .7492           | 88.0033                      | + .0147                  | .5049                               | + .0029     | .5078                    |
| 11           | .2236               | .7742           | 87.9978                      | + .0202                  | .4494                               | — .0040     | .4534                    |
| 12           | .2426               | .7731           | 88.0157                      | + .0023                  | .4695                               | + .0005     | .4700                    |
| 13           | .2626               | .7780           | 88.0406                      | — .0226                  | .4846                               | — .0045     | .4801                    |
| 14           | .2714               | .7650           | 88.0364                      | — .0184                  | .5064                               | — .0037     | .5027                    |
| 15           | .2570               | .7412           | 87.9982                      | + .0198                  | .5158                               | + .0040     | .5198                    |
| 16           | .2544               | .7470           | 88.0014                      | + .0166                  | .5074                               | + .0033     | .5107                    |
| 17           | .2495               | .7483           | 87.9978                      | + .0202                  | .5012                               | + .0040     | .5052                    |
| 18           | .2588               | .7796           | 88.0384                      | — .0204                  | .4792                               | — .0041     | .4751                    |
| 19           | .2605               | .7734           | 88.0339                      | — .0159                  | .4871                               | — .0032     | .4839                    |
| 20           | .2497               | .7824           | 88.0321                      | — .0141                  | .4673                               | — .0028     | .4645                    |
| 21           | .2491               | .7776           | 88.0267                      | — .0087                  | .4715                               | — .0017     | .4698                    |
| 22           | .2500               | .7828           | 88.0328                      | — .0148                  | .4672                               | — .0030     | .4642                    |
| 23           | .2371               | .7802           | 88.0173                      | + .0007                  | .4569                               | + .0001     | .4570                    |
| 24           | .2289               | .7862           | 88.0151                      | + .0029                  | .4427                               | + .0006     | .4433                    |
| 25           | .2356               | .7737           | 88.0093                      | + .0087                  | .4619                               | — .0017     | .4636                    |
| 26           | .2324               | .7818           | 88.0142                      | + .0038                  | .4506                               | — .0008     | .4514                    |
| 27           | .2366               | .7778           | 88.0144                      | + .0036                  | .4588                               | — .0007     | .4595                    |
| Mean.        |                     |                 | 88.0180                      |                          | Assumed Value, 6.4800               |             |                          |

TABLE IV.—OBSERVATIONAL DATA.

COMPARISON STARS *c* AND *d*.

| Plate<br>No.   | Corrected Distance. |                 | Sum.<br><i>c</i> + <i>d</i> . | Mean<br><i>Minus</i> Sum | Difference<br><i>c</i> — <i>d</i> . | Scale Corr. | Corrected<br>Difference. |
|----------------|---------------------|-----------------|-------------------------------|--------------------------|-------------------------------------|-------------|--------------------------|
|                | Star <i>c</i> .     | Star <i>d</i> . |                               |                          |                                     |             |                          |
| 4              | 121.4926            | 75.2954         | 196.7880                      | — .0202                  | 46.1972                             | — .0040     | 46.1932                  |
| 6              | .4826               | .3091           | .7917                         | — .0239                  | .1735                               | — .0048     | .1687                    |
| 7              | .5033               | .2631           | .7664                         | + .0014                  | .2402                               | + .0003     | .2405                    |
| 8              | .4960               | .2684           | .7644                         | + .0034                  | .2276                               | + .0007     | .2283                    |
| 9              | .4978               | .2661           | .7639                         | + .0039                  | .2317                               | + .0008     | .2325                    |
| 10             | .4954               | .2605           | .7559                         | + .0119                  | .2349                               | + .0024     | .2373                    |
| 11             | .4711               | .2842           | .7553                         | + .0125                  | .1869                               | + .0025     | .1894                    |
| 12             | .4750               | .2853           | .7603                         | + .0075                  | .1897                               | + .0015     | .1912                    |
| 15             | .4903               | .2538           | .7441                         | + .0237                  | .2365                               | + .0047     | .2412                    |
| 16             | .4996               | .2540           | .7536                         | + .0142                  | .2456                               | + .0028     | .2484                    |
| 17             | .4969               | .2505           | .7474                         | + .0204                  | .2464                               | + .0041     | .2505                    |
| 18             | .4996               | .2854           | .7850                         | — .0172                  | .2142                               | — .0034     | .2108                    |
| 19             | .5000               | .2979           | .7979                         | — .0301                  | .2021                               | — .0060     | .1961                    |
| 20             | .5016               | .2807           | .7823                         | — .0145                  | .2209                               | — .0029     | .2180                    |
| 22             | .4832               | .2985           | .7817                         | — .0139                  | .1847                               | — .0028     | .1819                    |
| 23             | .4906               | .2759           | .7665                         | + .0013                  | .2147                               | + .0003     | .2150                    |
| 24             | .4764               | .2933           | .7697                         | — .0019                  | .1831                               | — .0004     | .1827                    |
| 25             | .4778               | .2894           | .7672                         | + .0006                  | .1884                               | + .0001     | .1885                    |
| 26             | .4766               | .2762           | .7528                         | + .0150                  | .2004                               | + .0030     | .2034                    |
| 27             | .4779               | .2836           | .7615                         | + .0063                  | .1943                               | + .0013     | .1956                    |
| Mean, 196.7678 |                     |                 |                               |                          | Assumed Value, 46.2100              |             |                          |

TABLE IV.—OBSERVATIONAL DATA.

COMPARISON STARS *e* AND *f*.

| Plate No.      | Corrected Distance. |                 | Sum<br><i>e + f</i> . | Mean<br><i>minus</i> Sum | Difference<br><i>e - f</i> . | Scale Corr. | Corrected<br>Difference. |
|----------------|---------------------|-----------------|-----------------------|--------------------------|------------------------------|-------------|--------------------------|
|                | Star <i>e</i> .     | Star <i>f</i> . |                       |                          |                              |             |                          |
| I              | 64.7454             | 60.4758         | 125.2212              | — .0167                  | 4.2696                       | — .0017     | 4.2679                   |
| 6              | .7406               | .4776           | 2182                  | — .0137                  | .2630                        | — .0013     | .2617                    |
| 8              | .7483               | .4524           | .2007                 | + .0038                  | .2959                        | + .0004     | .2963                    |
| 9              | .7563               | .4531           | .2094                 | — .0049                  | .3032                        | — .0005     | .3027                    |
| 11             | .7099               | .4854           | .1953                 | + .0092                  | .2245                        | + .0009     | .2254                    |
| 12             | .7082               | .4911           | .1993                 | + .0052                  | .2171                        | + .0005     | .2176                    |
| 13             | .7010               | .5089           | .2099                 | — .0054                  | .1921                        | — .0005     | .1916                    |
| 14             | .7174               | .4965           | .2139                 | — .0094                  | .2209                        | — .0009     | .2200                    |
| 15             | .7367               | .4512           | .1879                 | + .0166                  | .2855                        | + .0017     | .2872                    |
| 16             | .7250               | .4599           | .1849                 | + .0196                  | .2651                        | + .0020     | .2671                    |
| 17             | .7221               | .4584           | .1805                 | + .0240                  | .2637                        | + .0024     | .2661                    |
| 18             | .7092               | .4969           | .2061                 | — .0016                  | .2123                        | — .0002     | .2121                    |
| 20             | .7169               | .4809           | .1978                 | + .0067                  | .2360                        | + .0007     | .2367                    |
| 22             | .7300               | .4811           | .2111                 | — .0066                  | .2489                        | — .0007     | .2482                    |
| 23             | .7449               | .4756           | .2205                 | — .0160                  | .2693                        | — .0016     | .2677                    |
| 24             | .7456               | .4676           | .2132                 | — .0087                  | .2780                        | — .0009     | .2771                    |
| 25             | .7322               | .4738           | .2060                 | — .0015                  | .2584                        | — .0002     | .2582                    |
| 27             | .7396               | .4656           | .2052                 | — .0007                  | .2740                        | — .0001     | .2739                    |
| Mean, 125.2045 |                     |                 | Assumed Value, 4.2540 |                          |                              |             |                          |

TABLE IV.—OBSERVATIONAL DATA.

COMPARISON STARS  $g$  AND  $h$ .

| Plate No. | Corrected Distance. |            | Sum<br>$g + h$ . | Mean<br>minus Sum | Difference<br>$g - h$ . | Scale Corr.    | Corrected<br>Difference. |
|-----------|---------------------|------------|------------------|-------------------|-------------------------|----------------|--------------------------|
|           | Star $g$ .          | Star $h$ . |                  |                   |                         |                |                          |
| 1         | 108.3264            | 100.6776   | 209.0040         | — .0213           | 7.6488                  | — .0021        | 7.6467                   |
| 4         | .3150               | .6915      | 209.0065         | — .0238           | .6235                   | — .0024        | .6211                    |
| 7         | .3151               | .6785      | 208.9936         | — .0109           | .6366                   | — .0011        | .6355                    |
| 8         | .3047               | .6785      | 208.9832         | — .0005           | .6262                   | — .0001        | .6261                    |
| 9         | .3063               | .6762      | 208.9825         | + .0002           | .6301                   | + .0000        | .6301                    |
| 10        | .2992               | .6905      | 208.9897         | — .0070           | .6087                   | — .0007        | .6080                    |
| 11        | .2783               | .6801      | 208.9584         | + .0243           | .5982                   | + .0024        | .6006                    |
| 12        | .2743               | .6936      | 208.9679         | + .0148           | .5807                   | + .0015        | .5822                    |
| 13        | .3015               | .7180      | 209.0195         | — .0368           | .5835                   | — .0037        | .5798                    |
| 14        | .2956               | .7102      | 209.0058         | — .0231           | .5854                   | — .0023        | .5831                    |
| 15        | .2905               | .6693      | 208.9598         | + .0229           | .6212                   | + .0023        | .6235                    |
| 16        | .2950               | .6752      | 208.9702         | + .0125           | .6198                   | + .0013        | .6211                    |
| 17        | .2910               | .6629      | 208.9539         | + .0288           | .6281                   | + .0029        | .6310                    |
| 18        | .2972               | .7020      | 208.9992         | — .0165           | .5952                   | — .0016        | .5936                    |
| 20        | .2885               | .6932      | 208.9817         | + .0010           | .5953                   | + .0001        | .5954                    |
| 23        | .3087               | .6796      | 208.9883         | — .0056           | .6291                   | — .0006        | .6285                    |
| 24        | .3024               | .6717      | 208.9741         | + .0086           | .6307                   | + .0009        | .6316                    |
| 25        | .2968               | .6788      | 208.9756         | + .0071           | .6180                   | + .0007        | .6187                    |
| 26        | .2991               | .6803      | 208.9794         | + .0033           | .6188                   | + .0003        | .6191                    |
| 27        | .2885               | .6720      | 208.9605         | + .0222           | .6165                   | + .0022        | .6187                    |
|           |                     | Mean,      | 208.9827         |                   |                         | Assumed Value, | 7.6100                   |

TABLE IV.—OBSERVATIONAL DATA.

COMPARISON STARS *i* AND *j*.

| Plate<br>No.   | Corrected Distance. |                 | Sum<br><i>i + j</i> . | Mean<br><i>minus</i> Sum | Difference<br><i>i - j</i> . | Scale Corr. | Corrected<br>Difference. |
|----------------|---------------------|-----------------|-----------------------|--------------------------|------------------------------|-------------|--------------------------|
|                | Star <i>i</i> .     | Star <i>j</i> . |                       |                          |                              |             |                          |
| 1              | 97.9511             | 93.3217         | 191.2728              | — .0390                  | 4.6294                       | — .0039     | 4.6255                   |
| 2              | .9621               | .3005           | .2626                 | — .0288                  | .6616                        | — .0029     | .6587                    |
| 4              | .9536               | .3102           | .2638                 | — .0300                  | .6434                        | — .0030     | .6404                    |
| 7              | .9062               | .3322           | .2384                 | — .0046                  | .5740                        | — .0005     | .5735                    |
| 8              | .9142               | .3137           | .2279                 | + .0059                  | .6005                        | + .0006     | .6011                    |
| 9              | .9135               | .3153           | .2288                 | + .0050                  | .5982                        | + .0005     | .5987                    |
| 10             | .9013               | .3124           | .2137                 | + .0201                  | .5889                        | + .0020     | .5909                    |
| 11             | .9102               | .3015           | .2117                 | + .0221                  | .6087                        | + .0022     | .6109                    |
| 12             | .9172               | .3025           | .2197                 | + .0141                  | .6147                        | + .0014     | .6161                    |
| 14             | .9327               | .3057           | .2384                 | — .0046                  | .6270                        | — .0005     | .6265                    |
| 15             | .9060               | .3139           | .2199                 | + .0139                  | .5921                        | + .0014     | .5935                    |
| 16             | .9038               | .3065           | .2103                 | + .0235                  | .5973                        | + .0024     | .5997                    |
| 18             | .9304               | .3179           | .2483                 | — .0145                  | .6125                        | — .0015     | .6110                    |
| 20             | .9121               | .3163           | .2284                 | + .0054                  | .5958                        | + .0005     | .5963                    |
| 21             | .9508               | .2985           | .2493                 | — .0155                  | .6523                        | — .0016     | .6507                    |
| 22             | .9449               | .3132           | .2581                 | — .0243                  | .6317                        | — .0024     | .6293                    |
| 23             | .9316               | .3025           | .2341                 | — .0003                  | .6291                        | — .0000     | .6291                    |
| 24             | .9298               | .2983           | .2281                 | + .0057                  | .6315                        | + .0006     | .6321                    |
| 25             | .9220               | .2925           | .2145                 | + .0193                  | .6295                        | + .0019     | .6314                    |
| 26             | .9248               | .2965           | .2213                 | + .0125                  | .6283                        | + .0012     | .6295                    |
| 27             | .9271               | .2926           | .2197                 | + .0141                  | .6345                        | + .0014     | .6359                    |
| Mean, 191.2338 |                     |                 |                       |                          | Assumed Value, 4.6200        |             |                          |

TABLE IV.—OBSERVATIONAL DATA.

COMPARISON STARS  $k$  AND  $l$ .

| Plate No.      | Corrected Distance. |            | Sum<br>$k + l$ | Mean<br><i>minus</i> Sum | Difference<br>$k - l$  | Scale Corr. | Corrected<br>Difference |
|----------------|---------------------|------------|----------------|--------------------------|------------------------|-------------|-------------------------|
|                | Star $k$ .          | Star $l$ . |                |                          |                        |             |                         |
| 1              | 76.4769             | 65.6116    | 142.0885       | — .0202                  | 10.8653                | — .0040     | 10.8613                 |
| 3              | .4789               | .6083      | .0872          | — .0189                  | .8706                  | — .0038     | .8668                   |
| 4              | .4862               | .6115      | .0977          | — .0294                  | .8747                  | — .0059     | .8688                   |
| 5              | .4861               | .6210      | .1071          | — .0388                  | .8651                  | — .0078     | .8573                   |
| 6              | .4750               | .6231      | .0981          | — .0298                  | .8519                  | — .0060     | .8459                   |
| 7              | .4821               | .5588      | .0409          | + .0274                  | .9233                  | + .0055     | .9288                   |
| 8              | .4786               | .5826      | .0612          | + .0071                  | .8960                  | + .0014     | .8974                   |
| 9              | .4756               | .5848      | .0604          | + .0079                  | .8908                  | + .0016     | .8924                   |
| 11             | .4723               | .5815      | .0538          | — .0145                  | .8908                  | + .0029     | .8937                   |
| 12             | .4578               | .5792      | .0370          | + .0313                  | .8786                  | + .0063     | .8849                   |
| 13             | .4914               | .6053      | .0967          | — .0284                  | .8861                  | — .0057     | .8804                   |
| 14             | .4915               | .5800      | .0715          | — .0032                  | .9115                  | — .0006     | .9109                   |
| 15             | .4720               | .5731      | .0451          | + .0232                  | .8989                  | + .0046     | .9035                   |
| 16             | .4787               | .5711      | .0498          | + .0185                  | .9076                  | + .0037     | .9113                   |
| 18             | .4886               | .5804      | .0690          | — .0007                  | .9082                  | — .0001     | .9081                   |
| 19             | .4958               | .5882      | .0840          | — .0157                  | .9076                  | — .0031     | .9045                   |
| 22             | .4828               | .5881      | .0709          | — .0026                  | .8947                  | — .0005     | .8942                   |
| 23             | .4679               | .6007      | .0686          | — .0003                  | .8672                  | — .0001     | .8671                   |
| 24             | .4654               | .6002      | .0656          | + .0027                  | .8652                  | + .0005     | .8657                   |
| 25             | .4576               | .5902      | .0478          | + .0205                  | .8674                  | + .0041     | .8715                   |
| 26             | .4693               | .5845      | .0538          | + .0145                  | .8848                  | + .0029     | .8877                   |
| 27             | .4630               | .5857      | .0487          | + .0196                  | .8773                  | + .0039     | .8812                   |
| Mean, 142.0683 |                     |            |                |                          | Assumed Value, 10.8860 |             |                         |

TABLE V.—PARALLAX EQUATIONS.

COMPARISON STARS *a* AND *b*.

| Plate. |               |                |                |       |     | <i>v</i>             |
|--------|---------------|----------------|----------------|-------|-----|----------------------|
| 1      | 1.00 <i>x</i> | —1.42 <i>y</i> | +1.49 <i>π</i> | —2.19 | = 0 | —2.61                |
| 4      | 1.00          | —1.41          | +1.56          | +0.09 | = 0 | —0.23                |
| 5      | 1.00          | —0.46          | +1.23          | —1.26 | = 0 | —1.11                |
| 6      | 1.00          | —0.46          | +1.23          | —2.68 | = 0 | —2.53                |
| 7      | 1.00          | —0.04          | —0.38          | +5.40 | = 0 | +3.93                |
| 8      | 1.00          | +0.01          | —0.89          | +1.48 | = 0 | —0.58                |
| 10     | 1.00          | +0.01          | —0.96          | +2.78 | = 0 | +0.64                |
| 11     | 1.00          | +0.50          | +0.85          | —2.66 | = 0 | —2.10                |
| 12     | 1.00          | +0.50          | +0.85          | —1.00 | = 0 | —0.44                |
| 13     | 1.00          | +0.55          | +1.29          | +0.01 | = 0 | +1.17                |
| 14     | 1.00          | +0.55          | +1.29          | +2.27 | = 0 | +3.43                |
| 15     | 1.00          | +1.02          | —1.08          | +3.98 | = 0 | +2.63                |
| 16     | 1.00          | +1.03          | —1.11          | +3.07 | = 0 | +1.69                |
| 17     | 1.00          | +1.03          | —1.11          | +2.52 | = 0 | +1.14                |
| 18     | 1.00          | +1.54          | +1.20          | —0.49 | = 0 | +1.48                |
| 19     | 1.00          | +1.54          | +1.20          | +0.39 | = 0 | +2.36                |
| 20     | 1.00          | +1.55          | +1.31          | —1.55 | = 0 | +0.56                |
| 21     | 1.00          | +1.55          | +1.31          | —1.02 | = 0 | +1.09                |
| 22     | 1.00          | +1.56          | +1.33          | —1.58 | = 0 | +0.57                |
| 23     | 1.00          | +1.96          | —0.39          | —2.30 | = 0 | —1.92                |
| 24     | 1.00          | +1.96          | —0.39          | —3.67 | = 0 | —3.29                |
| 25     | 1.00          | +1.97          | —0.48          | —1.64 | = 0 | —1.37                |
| 26     | 1.00          | +1.97          | —0.48          | —2.86 | = 0 | —2.59                |
| 27     | 1.00          | +1.97          | —0.57          | —2.05 | = 0 | —1.89                |
|        |               |                |                |       |     | $\Sigma v^2 = 95.45$ |

## Normal Equations.

$$\begin{aligned}
 +24.0000x + 18.9800y + 8.3000\pi - 4.9600 &= 0 \\
 +40.0044 - 1.2806 - 17.3438 &= 0 \\
 +27.1124 - 24.6113 &= 0
 \end{aligned}$$

## Solution.

In units of 2d dec. place.

In Arc.

$$\begin{aligned}
 \pi &= +1.2446 \pm 0.3080 & \pi &= +0.3486'' \pm 0.0863'' \\
 y &= +0.9276 \pm 0.2877 & y &= +0.2598'' \pm 0.0806'' \\
 x &= -0.9574 \pm 0.2936 & x &= -0.2682'' \pm 0.0822''
 \end{aligned}$$

Scale.

Arc.

$$\text{Probable error of one equation} = \pm 1.438 = \pm 0''.403$$

TABLE V.—PARALLAX EQUATIONS.

COMPARISON STARS  $c$  AND  $d$ .

| Plate. |           |           |             |       |     | $v$                  |
|--------|-----------|-----------|-------------|-------|-----|----------------------|
| 4      | 1.00. $x$ | —1.41 $y$ | +1.76 $\pi$ | —1.68 | = 0 | —0.67                |
| 6      | 1.00      | —0.46     | +1.48       | —4.13 | = 0 | —2.94                |
| 7      | 1.00      | —0.04     | —0.65       | +3.05 | = 0 | +1.56                |
| 8      | 1.00      | +0.01     | —1.15       | +1.83 | = 0 | —0.32                |
| 9      | 1.00      | +0.01     | —1.15       | +2.25 | = 0 | +0.10                |
| 10     | 1.00      | +0.01     | —1.23       | +2.73 | = 0 | +0.47                |
| 11     | 1.00      | +0.50     | +1.12       | —2.06 | = 0 | —0.80                |
| 12     | 1.00      | +0.50     | +1.12       | —1.88 | = 0 | —0.62                |
| 15     | 1.00      | +1.02     | —1.34       | +3.12 | = 0 | +1.31                |
| 16     | 1.00      | +1.03     | —1.36       | +3.84 | = 0 | +2.01                |
| 17     | 1.00      | +1.03     | —1.36       | +4.05 | = 0 | +2.22                |
| 18     | 1.00      | +1.54     | +1.46       | +0.08 | = 0 | +2.42                |
| 19     | 1.00      | +1.54     | +1.46       | —1.39 | = 0 | +0.95                |
| 20     | 1.00      | +1.55     | +1.55       | +0.80 | = 0 | +3.27                |
| 22     | 1.00      | +1.56     | +1.57       | —2.81 | = 0 | —0.31                |
| 23     | 1.00      | +1.96     | —0.67       | +0.50 | = 0 | +0.16                |
| 24     | 1.00      | +1.96     | —0.67       | —2.73 | = 0 | —3.07                |
| 25     | 1.00      | +1.97     | —0.76       | —2.15 | = 0 | —2.61                |
| 26     | 1.00      | +1.97     | —0.76       | —0.66 | = 0 | —1.02                |
| 27     | 1.00      | +1.97     | —0.84       | —1.44 | = 0 | —2.01                |
|        |           |           |             |       |     | $\Sigma v^2 = 62.46$ |

Normal Equations.

$$\begin{aligned}
 +20.0000x + 18.2200y - 0.4200\pi + 1.3200 &= 0 \\
 +34.7690 &- 4.1472 &- 4.3505 &= 0 \\
 +29.7612 &- 38.6706 &= 0
 \end{aligned}$$

Solution.

In units of 2d dec. place.

In Arc.

$$\begin{aligned}
 \pi &= +1.3735 \pm 0.3002 & \pi &= +0''.3847 \pm 0''.0841 \\
 y &= +0.5902 \pm 0.3036 & y &= +0.1653 \pm 0.0850 \\
 x &= -0.5748 \pm 0.2828 & x &= -0.1610 \pm 0.0792
 \end{aligned}$$

Scale.

Arc.

$$\text{Probable error of one equation} = \pm 1.293 = \pm 0''.362.$$



TABLE V.—PARALLAX EQUATIONS.

COMPARISON STARS  $e$  AND  $f$ .

| Plate. |          |           |             |       |     |  | $v$                  |
|--------|----------|-----------|-------------|-------|-----|--|----------------------|
| 1      | 1.00 $x$ | —1.42 $y$ | +1.04 $\pi$ | +1.39 | = 0 |  | +0.53                |
| 6      | 1.00     | —0.46     | +1.30       | +0.77 | = 0 |  | +1.74                |
| 8      | 1.00     | +0.01     | —1.44       | +4.23 | = 0 |  | +0.27                |
| 9      | 1.00     | +0.01     | —1.44       | +4.87 | = 0 |  | +0.28                |
| 11     | 1.00     | +0.50     | +1.52       | —2.86 | = 0 |  | —0.15                |
| 12     | 1.00     | +0.50     | +1.52       | —3.64 | = 0 |  | —0.93                |
| 13     | 1.00     | +0.55     | +1.25       | —6.24 | = 0 |  | —4.01                |
| 14     | 1.00     | +0.55     | +1.25       | —3.40 | = 0 |  | —1.17                |
| 15     | 1.00     | +1.02     | —1.33       | +3.32 | = 0 |  | +0.95                |
| 16     | 1.00     | +1.03     | —1.32       | +1.31 | = 0 |  | —1.02                |
| 17     | 1.00     | +1.03     | —1.32       | +1.21 | = 0 |  | —1.12                |
| 18     | 1.00     | +1.54     | —1.32       | —4.19 | = 0 |  | —0.48                |
| 20     | 1.00     | +1.55     | +1.23       | —1.73 | = 0 |  | +1.81                |
| 22     | 1.00     | +1.56     | +1.21       | —0.58 | = 0 |  | +2.93                |
| 23     | 1.00     | +1.96     | —1.58       | +1.37 | = 0 |  | —0.24                |
| 24     | 1.00     | +1.96     | —1.58       | +2.31 | = 0 |  | +0.70                |
| 25     | 1.00     | +1.97     | —1.56       | +0.42 | = 0 |  | —1.14                |
| 27     | 1.00     | +1.97     | —1.55       | +1.99 | = 0 |  | +0.45                |
|        |          |           |             |       |     |  | $\Sigma v^2 = 39.13$ |

## Normal Equations.

$$\begin{aligned}
 +18.0000x + 15.8300y - 1.4800\pi + 0.5500 &= 0 \\
 +29.1481 - 9.7778 - 2.8854 &= 0 \\
 +34.4666 - 58.2440 &= 0
 \end{aligned}$$

## Solution.

| In units of 2d dec. place. | In Arc.                    |
|----------------------------|----------------------------|
| $\pi = +2.0277 \pm 0.2001$ | $\pi = +0.5680 \pm 0.0560$ |
| $y = +1.3500 \pm 0.2792$   | $y = +0.3781 \pm 0.0782$   |
| $x = -1.0511 \pm 0.2567$   | $x = -0.2944 \pm 0.0719$   |

| Scale.                                       | Arc.            |
|--|-----------------|
| Probable error of one equation = $\pm 1.089$ | = $\pm 0.''305$ |

TABLE V.—PARALLAX EQUATIONS.

| COMPARISON STARS $g$ AND $h$ . |          |           |             |       |     |                    |
|--------------------------------|----------|-----------|-------------|-------|-----|--------------------|
| Plate.                         |          |           |             |       |     | $v$                |
| 1                              | 1.00 $x$ | —1.42 $y$ | +0.17 $\pi$ | +3.67 | = 0 | +2.75              |
| 4                              | 1.00     | —1.41     | +0.04       | +1.11 | = 0 | —0.11              |
| 7                              | 1.00     | —0.04     | —1.01       | +2.55 | = 0 | —0.02              |
| 8                              | 1.00     | +0.01     | —0.76       | +1.61 | = 0 | —0.29              |
| 9                              | 1.00     | +0.01     | —0.76       | +2.01 | = 0 | +0.11              |
| 10                             | 1.00     | +0.01     | —0.70       | —0.20 | = 0 | —1.96              |
| 11                             | 1.00     | +0.50     | +0.84       | —0.94 | = 0 | +1.31              |
| 12                             | 1.00     | +0.50     | +0.84       | —2.78 | = 0 | —0.53              |
| 13                             | 1.00     | +0.55     | +0.42       | —3.02 | = 0 | —1.72              |
| 14                             | 1.00     | +0.55     | +0.42       | —2.69 | = 0 | —1.39              |
| 15                             | 1.00     | +1.02     | —0.59       | +1.35 | = 0 | +0.65              |
| 16                             | 1.00     | +1.03     | —0.56       | +1.11 | = 0 | +0.49              |
| 17                             | 1.00     | +1.03     | —0.56       | +2.10 | = 0 | +1.48              |
| 18                             | 1.00     | +1.54     | +0.52       | —1.64 | = 0 | +0.72              |
| 20                             | 1.00     | +1.55     | +0.40       | —1.46 | = 0 | +0.62              |
| 23                             | 1.00     | +1.96     | —1.10       | +1.85 | = 0 | +0.73              |
| 24                             | 1.00     | +1.96     | —1.10       | +2.16 | = 0 | +1.04              |
| 25                             | 1.00     | +1.97     | —1.05       | +0.87 | = 0 | —0.13              |
| 26                             | 1.00     | +1.97     | —1.05       | +0.91 | = 0 | —0.09              |
| 27                             | 1.00     | +1.97     | —0.99       | +0.87 | = 0 | +0.02              |
|                                |          |           |             |       |     | $\Sigma v^2=23.80$ |

Normal Equations.

$$\begin{aligned}
 +20.0000x + 15.2600y - 6.5800\pi + 9.4400 &= 0 \\
 +32.3736 - 9.7115 + 1.1300 &= 0 \\
 +11.4706 - 21.2136 &= 0
 \end{aligned}$$

Solution.

| In units of 2d dec. place.  | In Arc.                     |
|-----------------------------|-----------------------------|
| $\pi = + 2.3631 \pm 0.2780$ | $\pi = + 0.6619 \pm 0.0779$ |
| $y = + 0.8277 \pm 0.1753$   | $y = + 0.2318 \pm 0.0491$   |
| $x = - 0.1459 \pm 0.1760$   | $x = - 0.4087 \pm 0.0493$   |

Scale.      Arc.

Probable error of one equation =  $\pm 0.798 = \pm 0''.274$

TABLE V.—PARALLAX EQUATIONS.

| COMPARISON STARS <i>i</i> AND <i>j</i> . |               |                |                |       |     |                      |
|--|---------------|----------------|----------------|-------|-----|----------------------|
| Plate.                                   |               |                |                |       |     | <i>v</i>             |
| 1  | 1.00 <i>x</i> | —1.42 <i>y</i> | —1.05 <i>π</i> | +0.55 | = 0 | —0.23                |
| 2  | 1.00          | —1.42          | —1.05          | +3.87 | = 0 | +3.09                |
| 4  | 1.00          | —1.41          | —1.15          | +2.04 | = 0 | +1.02                |
| 7  | 1.00          | —0.04          | —0.12          | —4.65 | = 0 | —3.79                |
| 8  | 1.00          | +0.01          | +0.38          | —1.89 | = 0 | +0.13                |
| 9  | 1.00          | +0.01          | +0.38          | —2.13 | = 0 | —0.11                |
| 10                                       | 1.00          | +0.01          | +0.47          | —2.91 | = 0 | —0.68                |
| 11                                       | 1.00          | +0.50          | —0.32          | —0.91 | = 0 | —0.73                |
| 12                                       | 1.00          | +0.50          | —0.32          | —0.39 | = 0 | —0.21                |
| 14                                       | 1.00          | +0.55          | —0.81          | +0.65 | = 0 | —0.35                |
| 15                                       | 1.00          | +1.02          | +0.60          | —2.65 | = 0 | —0.51                |
| 16                                       | 1.00          | +1.03          | +0.62          | —2.03 | = 0 | +0.15                |
| 18                                       | 1.00          | +1.54          | —0.71          | —0.90 | = 0 | —2.06                |
| 20                                       | 1.00          | +1.55          | —0.84          | —2.37 | = 0 | —3.83                |
| 21                                       | 1.00          | +1.55          | —0.84          | +3.07 | = 0 | +1.60                |
| 22                                       | 1.00          | +1.56          | —0.86          | +0.93 | = 0 | —0.59                |
| 23                                       | 1.00          | +1.96          | —0.11          | +0.91 | = 0 | +1.00                |
| 24                                       | 1.00          | +1.96          | —0.11          | +1.21 | = 0 | +1.30                |
| 25                                       | 1.00          | +1.97          | —0.02          | +1.14 | = 0 | +1.44                |
| 26                                       | 1.00          | +1.97          | —0.02          | +0.95 | = 0 | +1.25                |
| 27                                       | 1.00          | +1.97          | +0.06          | +1.59 | = 0 | +2.08                |
|  |               |                |                |       |     | $\Sigma v^2 = 58.95$ |

## Normal Equations.

$$\begin{aligned}
 +21.0000x + 15.3700y - 5.8200\pi - 3.9200 &= 0 \\
 +37.8627 - 0.3251 - 1.5679 &= 0 \\
 +8.3404 - 13.2118 &= 0
 \end{aligned}$$

## Solution.

| In units 2d dec. place.    | In Arc.                    |
|----------------------------|----------------------------|
| $\pi = +2.3578 \pm 0.4923$ | $\pi = +0.6604 \pm 0.1379$ |
| $y = -0.3975 \pm 0.2366$   | $y = -0.1113 \pm 0.0663$   |
| $x = +1.1310 \pm 0.2664$   | $x = +0.3168 \pm 0.0746$   |

| Scale.                                       | Are.            |
|--|-----------------|
| Probable error of one equation = $\pm 1.221$ | = $\pm 0''.342$ |

TABLE V.—PARALLAX EQUATIONS.

| COMPARISON STARS $k$ AND $l$ . |          |           |             |       |     |                      |
|--------------------------------|----------|-----------|-------------|-------|-----|----------------------|
| Plate.                         |          |           |             |       |     | $r$                  |
| 1                              | 1.00 $x$ | —1.42 $y$ | +1.11 $\pi$ | —2.47 | = 0 | —1.13                |
| 3                              | 1.00     | —1.41     | +1.21       | —1.92 | = 0 | —0.47                |
| 4                              | 1.00     | —1.41     | +1.21       | —1.72 | = 0 | —0.27                |
| 5                              | 1.00     | —0.46     | +0.81       | —2.87 | = 0 | —2.08                |
| 6                              | 1.00     | —0.46     | +0.81       | —4.01 | = 0 | —3.22                |
| 7                              | 1.00     | —0.04     | +0.06       | +4.28 | = 0 | +4.17                |
| 8                              | 1.00     | +0.01     | —0.45       | +1.14 | = 0 | +0.47                |
| 9                              | 1.00     | +0.01     | —0.45       | +0.64 | = 0 | —0.03                |
| 11                             | 1.00     | +0.50     | +0.39       | +0.77 | = 0 | +0.87                |
| 12                             | 1.00     | +0.50     | +0.39       | —0.11 | = 0 | —0.01                |
| 13                             | 1.00     | +0.55     | +0.88       | —0.56 | = 0 | +0.05                |
| 14                             | 1.00     | +0.55     | +0.88       | +2.49 | = 0 | +3.10                |
| 15                             | 1.00     | +1.02     | —0.66       | +1.75 | = 0 | +0.61                |
| 16                             | 1.00     | +1.03     | —0.68       | +2.53 | = 0 | +1.36                |
| 18                             | 1.00     | +1.54     | +0.77       | +2.21 | = 0 | +2.45                |
| 19                             | 1.00     | +1.54     | +0.77       | +1.85 | = 0 | +2.09                |
| 22                             | 1.00     | +1.56     | +0.92       | +0.82 | = 0 | +1.22                |
| 23                             | 1.00     | +1.96     | +0.05       | —1.89 | = 0 | —2.51                |
| 24                             | 1.00     | +1.96     | +0.05       | —2.03 | = 0 | —2.65                |
| 25                             | 1.00     | +1.97     | —0.04       | —1.45 | = 0 | —2.17                |
| 26                             | 1.00     | +1.97     | —0.04       | +0.17 | = 0 | —0.55                |
| 27                             | 1.00     | +1.97     | —0.12       | —0.48 | = 0 | —1.29                |
|                                |          |           |             |       |     | $\Sigma v^2 = 78.32$ |

Normal Equations.

$$\begin{aligned}
 +22.0000x + 13.4400y + 7.8700\pi - 0.8600 &= 0 \\
 +36.1266 - 2.1518 + 13.8148 &= 0 \\
 +10.6869 - 10.3893 &= 0
 \end{aligned}$$

Solution.

| In units of 2d dec. place. | In Arc.                    |
|----------------------------|----------------------------|
| $\pi = +1.0603 \pm 0.5529$ | $\pi = +0.2970 \pm 0.1549$ |
| $y = -0.2493 \pm 0.2591$   | $y = -0.0698 \pm 0.0726$   |
| $x = -0.1879 \pm 0.2919$   | $x = -0.0526 \pm 0.0818$   |

| Scale.                                       | Arc.            |
|--|-----------------|
| Probable error of one equation = $\pm 1.370$ | = $\pm 0.''384$ |

## XII.—*On Certain Bacteria from the Air of New York City.\**

BY HARRISON G. DYAR, A. M.

Read February 18, 1895.

It was suggested to me by Dr. T. Mitchell Prudden that a promising field for research existed in determining the identity of the bacteria commonly occurring in the air of New York.

Very early in the investigation a practical difficulty in the way of determining species became apparent. This resulted from the lack of any monographic treatment of the subject from the specific point of view. I find the same difficulty is met with by other investigators. Dr. Paul Schneider begins his inaugural address with these words: "Im Laufe der letzten Jahre sind nach und nach eine solche Menge verschiedener Bakterienarten beschrieben worden, dass es demjenigen, der sich nicht fortwährend damit beschäftigt, zur Zeit ganz unmöglich ist, sich in dieser Pflanzengruppe, die zwar arm an Formen, aber reich in Arten ist, zurecht zu finden."

It was thought that this difficulty could be overcome by the facilities possessed by the bacterial laboratory in the College of Physicians and Surgeons of Columbia College, with its considerable collection of living species, which might be directly compared with those obtained from the air. Further, a collection of fifty species was ordered from Král's bacterial laboratory at Prague with this special object in view. It was found, however, that the determinations of the species were not always authentic, as seen by the fact that when planted on the standard media many of them contradicted their published characters. The only cultures on which dependence could be placed were a few authentic ones which the college has received, identified by Dr. Sternberg, and those species from the college collection which Dr. Cheesman has had occasion to work out. Therefore, I have had to rely mostly on the published descriptions for identification of my cultures.

\* Submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy, in the University Faculty of Pure Science, Columbia College.

For this reason, I have felt some hesitation about describing new species, but I see no other so satisfactory way of treating the undetermined cultures. The method of simply describing them without the application of a scientific name is eminently confusing, as I have experienced in going over the literature. I do not think it should be commended even though it may avoid the possible creation of synonymic names.

• SPECIES AMONG THE BACTERIA.

The appearance of the new work on water bacteria\* by the Franklands, with its appendix repeating the old descriptions of bacteria, brings up again the practical difficulty in the determination of species. There is nothing to be said of these descriptions which would not apply equally to those of any of the recent diagnostic treatises such as those of Eisenberg or Sternberg; all are in an equally unsatisfactory condition.

This condition is due not to a lack of discrimination on the part of the authors of these works, but to a faulty method of describing species which has come to be prevalent. The result is illustrated in Frankland's synoptic table, which, for example, contains ninety species under a single heading (bacilli which liquefy gelatin, p 396), these species only to be distinguished by laboriously reading through the several descriptions, many of which present no tangible points of difference. Dr. Sternberg, too, has made a valiant and praiseworthy effort to prepare a "bacterial diagnosis" (See Manual of Bacteriology, pp. 753-768), but the positive differential characters given in the several descriptions became exhausted long before he reached the separation of individual species.

Let us look into the matter a little further. *La Semaine Médicale* of June 16, 1894, contains an article by Drs. F. Helme and Paul Raugé, in which the authors review the characters which are in use to separate the genera and species of the bacteria. As they point out the ultimate characters used to separate species are physiological. The generic characters are morphological, but of such a nature as would scarcely be considered reliable among the higher forms. This results from the simple organization of the bacteria. As we proceed from the higher to the lower forms

\* "Micro-organisms in Water," by Percy Frankland, Ph. D., and Mrs. Percy Frankland (1894).

of life, the organization becomes simpler, till with the bacteria we reach organisms which present extremely slight differences, so slight that morphology almost fails to furnish generic characters, and entirely fails to differentiate every species.

If conjugation is absent among the bacteria, and has never been present, the cells reproducing always by fission into equivalent parts, a condition of affairs should exist such as assumed by Weismann for the primitive form of life, and we should see all characters acquired by any species under the influence of external conditions, strictly inherited. In this case, there would be no such thing as species among the bacteria, merely an indefinite number of intergrading varieties. A given culture would probably show constant characters, but it would scarcely be expected that another culture would ever be found to show exactly the same characters.

But owing to the nature of the bacteria, dependent, for the most part, on previously prepared nourishment, it seems more probable that they are degraded forms, perhaps derived from ancestors in which the sexual process was represented. Moreover, the strict inheritance of acquired characters does not occur, since modified species may return to their original characters. Further, it is scarcely possible to eliminate the effects of selective action, which may be the true agent in producing the differences seen in species apparently modified by the environment. Also the power of spore formation under appropriate conditions seems to show that the "germ plasm" and "somatoplasm" of these lowly organisms are not identical.

In view of these considerations, it seems safer to regard the species of bacteria as true species, doubtless variable within certain limits, possibly sometimes polymorphic, but on the whole comparable with species in the higher forms of life. Still the absence of amphimixis must show an effect in a multiplication of races (in contradistinction to varieties) in excess of the number of such forms to be met with higher in the organic scale.

The generic characters are discussed pretty fully by Drs. Helme and Raugé in the article above alluded to. They conclude that the best characters available are the form of the elements and their mode of association; that is, they endorse the present arrangement. As regards motility, they discard it. They say: "ce caractère n'offre ni assez de variété, ni surtout assez de constance, pour apporter dans une nomenclature des données quelque

peu précises." They overlook the fact that though the motility may vary, the flagella may be uniformly present as shown by Moore in the case of *B. coli-communis*,\* and further the varying arrangement of these flagella when present, as shown by the classification of Messea.† It appears to the writer, that with a perfectly satisfactory method of staining, the structures upon which motility depends should form the basis of a more nearly natural classification than any in general use. At present, however, the practical difficulties are too great to allow of rapid and accurate work on such a basis.

So far, then, as generic characters go, these are, or may be based upon morphology, as in the higher forms of life. But not so with specific characters. Here morphology fails, for the minor differences in structure, pattern or coloration, etc., which we are accustomed to use, are either lacking, or so slight as to be inappreciable. To separate species, we have to fall back upon physiological characters. In other words, we place the several species under approximately uniform abnormal conditions (artificial cultures) and note their behavior. Perhaps we may be justified in assuming that the several individuals of a species will behave somewhat in the same manner under these definite abnormal conditions, but we have no criterion as to the extent of variation to be expected. Physiological characters have not been used to a sufficient extent among other groups of living things to enable us to predict whether they are more variable than the characters ordinarily used or not. Clearly it is a mistake to assume that they are less variable, though this assumption seems to have been very often tacitly made.

But granting that the physiological characters are sufficiently constant for practical use, we must have enough of them to be able to distinguish positively between every species. The liquefaction of gelatin is not enough. The characters of growth forms and color are often too variable, too similar, indefinite or difficult to describe recognizably. We should have more positive tests, and as such are not wanting they should be universally applied. It is impossible to say how many are needed; this can only be shown by experiment, and when we finally get some idea of the extent of the bacterial flora of the world.

\* V. A. Moore, *Wilder Quarter Century Book*, pp. 339-365.

† Messea, *Rivista d'igiene e sanita publica*, No. 14, p. 513 (1889).



## IDENTIFICATION OF OLD DESCRIPTIONS.

IN regard to insufficiently described species, two courses seem open. We may discard the names of all such and redescribe each as it occurs, or we may apply the name to any species which does not contradict the author's original description and complete the characters from that species. To assist in the recognition of specific descriptions in the higher forms of life, there is usually to be found the original example, or "type," which was before the author and from which it can always be learned what form was intended by the description, however imperfect; when the type is lost, the description, if unrecognizable, is discarded. But in the bacteria, the preservation of types is for the most part, out of the question (since they must be alive), and the former course becomes objectionable, not only in that such a large number of names would have to be discarded, but also that this number would be variable in the opinion of different authors. Further, as time went on, the discovery of new species might render the description of an old one incomplete. According to the second course, every name is to be preserved, the imperfect description being completed by subsequent authors, provided they do not identify as the old species a form which in any way contradicts the original description, and all additions so made are to become a part of the characters of the species. It would appear either that all imperfect descriptions should in future be omitted from our books, or some concerted attempt should be made to complete them. If the latter course be thoroughly applied, and authors can be induced to refrain from describing new species unless no old name can be made to apply, and further, if a new name seems necessary, to show good characters by which the new form can be distinguished from its nearest allies, then we ought in time to obtain a series of characterizations from which it would be easy to determine a given species, and the science of descriptive bacteriology might be placed on a footing of partial equality with other branches of natural science.

It is to be remarked that this branch of the subject has suffered from its close connection with the study of medicine. Not only have the non-pathogenic saprophytes received scant attention, but the eager desire to isolate the active agent in the cause of diseases has led to the naming of many bacteria from very insufficient characters. It would seem that descriptive bacteriology belongs to the

department of Botany,\* not to medicine which should rather concern itself with the application of bacteriology to medical subjects.

To summarize then, the present state of bacteriology is this: while some five hundred species of bacteria have been described, it appears that this number is far from covering the entire flora, since apparently new species are met with on every hand. This mass of descriptions is rather a hindrance than a help to further work, for not only are many species imperfectly described as compared with others, but the general standard of specific descriptions is inadequate to give characters to separate with clearness those species already known. Again it is known that species vary, but to what extent is not known. These three factors, then, imperfect knowledge of the flora, incomplete descriptions and ignorance of the extent of variation, tend to render identification of species uncertain, and discourage workers in this field. It is hoped that the present contribution may tend in some small measure to mitigate each of these evils.

#### VARIATION IN BACTERIA.

Some experiments were undertaken to give an idea of the range of variation in a given species. The results are largely in accordance with the very satisfactory conclusions expressed by Dr. A. Rodet in his recent valuable treatise on variability of bacteria.† Rodet concludes that the several forms of bacteria are generally constant, but that they are to be regarded as different races of comparatively few species. I shall not enter into a discussion of former work on variability, as this has been much better done by Dr. Rodet than I could hope to do within the limits of this paper. I refer to his work.

The following experiments were directed principally toward the point whether the variations among bacteria are generally of the nature of "acquired characters," *i. e.*, due to differences in the environment as seems to have been generally assumed‡ or rather

\* Or Zoölogy, if we follow Ernst Haeckel's *Systemat. Phylogenie der Protisten und Pflanzen*, Berlin 1894.

† *De la variabilité dans les microbes au point de vue Morphologique et Physiologique*, par le Dr. A. Rodet (1894).

‡ See Dr. J. G. Adami on the variability of bacteria and the development of races, *Medicine Chronicle*, September, 1892. Also Dr. A. S. Packard on the inheritance of acquired characters, etc., *Proc. American Academy* 1895, pp. 343-344.

"spontaneous variations," occurring in different individuals in the same stock under essentially identical conditions, such as we see among the higher organisms and the mode of occurrence of which has been explained by Weismann as the effect of amphimixis, or, as would apply more exactly to this case, of bud variation by an "abnormal differential nuclear division" (Germ-plasm. p. 442).

*Bacillus lactis erythrogenes* was selected as the subject of variation experiment. I have shown in a short paper read before the New York Academy of Sciences\* that many closely allied and variable forms are to be met with in nature, some of them clearly to be referred to this species, others doubtful. A knowledge of the degree of spontaneous variation of this germ was very desirable in the special relation of determining the standing of these forms, as well as in the general one of the nature of variation in bacteria. It was thought that light might be thrown on both subjects by a study of this species.

#### SPONTANEOUS VARIATION.

##### 1—*Slight Continuous Variations.*

The variations were tested as to the liquefaction of gelatin, the coagulation of milk, the reduction of nitrate to nitrite, and the amount of pigment produced in an agar culture.

*B. lactis erythrogenes* commonly produces a quick liquefaction of gelatin; it forms a soft flaky coagulum in milk which on boiling has no consistence and which is gradually dissolved; it reduces the nitrate solution † partially so that the test gives a faint red color, about half way between the deepest tint that can be produced and no color; in other cases completely; in an agar culture, the mass of growth is yellow and a pink tint is seen in the medium.

A culture was selected for experiment, taken from the air, in which the liquefaction of gelatin was rapid (normal), action on milk normal, the pink tint good, the yellow paler than usual, somewhat whitish, and nitrate scarcely reduced at all, in twenty-eight days only showing a faint trace of color with the test. From the culture a series of gelatin plates were made by dilutions. From one of the plates, separate cultures were made in ten tubes,

\* Published in the "Transactions" for 1895.

† The formulas for all media used are given at the end of this article.

the first five from surface colonies, the last five from deep ones, and these were all planted at the same time on media exactly alike, and grown on the same shelf under conditions as nearly alike as possible. The following tables exhibit their relative rate of growth. Number 7 failed to grow, probably because no bacilli were actually transferred from the colony, it being a "deep" one.

∞(The distance of the line to the right in each column indicates the comparative amount of action each culture had produced. For example, in first table on seventh day, No. 2 was farthest advanced and No. 6 least.)

LACTOSE-LITMUS GELATIN.

| NUMBER. | 2 DAYS.           | 4 DAYS.        | 7 DAYS.            | 10 DAYS. | 12 DAYS. | 14 DAYS. |
|---------|-------------------|----------------|--------------------|----------|----------|----------|
| 1       | Slight<br>liquef. | Cup<br>shaped. | Decolor-<br>izing. |          |          |          |
| 2       |                   |                |                    |          |          |          |
| 3       |                   |                |                    |          |          |          |
| 4       |                   |                |                    |          |          |          |
| 5       |                   |                |                    |          |          |          |
| 6       | (Not liq.)        |                |                    |          |          |          |
| 8       |                   |                |                    |          |          |          |
| 9       |                   |                |                    |          |          |          |
| 10      |                   |                |                    |          |          |          |

MILK .21 CC. ACID.\*

| NUMBER. | 4 DAYS.            | 7 DAYS. | 9 DAYS. | 11 DAYS. | 14 DAYS. |
|---------|--------------------|---------|---------|----------|----------|
| 1       | (No<br>change.)    |         |         |          |          |
| 2       | (A co-<br>agulum.) |         |         |          |          |
| 3       |                    |         |         |          |          |
| 4†      |                    |         |         |          |          |
| 5       |                    |         |         |          |          |
| 6       |                    |         |         |          |          |
| 8       |                    |         |         |          |          |
| 9       |                    |         |         |          |          |
| 10      |                    |         |         |          |          |

\* Each cc. required .21 cc. tenth normal NaOH to render neutral to phenol-  
ptalein.

† Not planted at the same time as the others.

## MILK .30 CC. ACID.

| NUMBER. | 4 DAYS.    | 7 DAYS.         | 9 DAYS.      | 12 DAYS. | 14 DAYS. |
|---------|------------|-----------------|--------------|----------|----------|
| 1       | No effect. | Not positively. | (No change.) |          |          |
| 2       | ..         | "               |              |          |          |
| 3       | ..         | ..              |              |          |          |
| 4*      | ..         | ..              |              |          |          |
| 5       | ..         | ..              |              |          |          |
| 6       | ..         | ..              |              |          |          |
| 8       | ..         | ..              |              |          |          |
| 9       | ..         | ..              |              |          |          |
| 10      | ..         | ..              |              |          |          |

## REDUCTION OF NITRATE.

| NUMBER. | 6 DAYS.      | 13 DAYS. | 20 DAYS.       | 28 DAYS. |
|---------|--------------|----------|----------------|----------|
| 1       | (No action.) |          | (Faint trace)  |          |
| 2       |              |          |                |          |
| 3       |              |          |                |          |
| 4       |              |          |                |          |
| 5       |              |          |                |          |
| 6       |              |          |                |          |
| 8       |              |          | (Not reduced.) |          |
| 9       |              |          |                |          |
| 10      |              |          | (Faint.)       |          |

As the rate of action of the culture on its medium depends a good deal on the "dose," or the number of bacteria introduced on the inoculation needle, the effect of this factor must be allowed for. There is no way of regulating this adequately; but I think the above table shows that there is individual variation in the descendents of a single cell, apparently independently of the environment. The number of the cultures practically eliminates the effect of the dose, when we take an average of them. It will be noticed that on the whole No. 10 produces the most marked effect, and No. 8 the least.

I find that in taking cultures in the ordinary manner from one tube to a new one by taking up a mass of growth on the needle,

\* Not planted at the same time as the others.

the resulting cultures tend to exhibit the same characters as the parent culture. When, however, cultures are made from separate colonies from a plate, the individual variations tend to become much more apparent, as the above shows.

To proceed with the experiments. Having obtained cultures derived from a single one but with slightly different characters, I proceeded to test these further, with the application of selection, as follows :

(1) No. 6 was selected as showing the least power of liquefying gelatin and a series of plates were made from it by dilution. Of the resulting colonies, nine were planted on gelatin and of these nine I selected the one which liquefied gelatin most rapidly and the one which liquefied the least so (for there was a considerable difference, as in the first instance) and planted them side by side with the original No. 6. Here is the result in tabular form as before :

|                               | 2 DAYS. | 4 DAYS. | 6 DAYS. | 9 DAYS. | 12 DAYS. | 14 DAYS. |
|-------------------------------|---------|---------|---------|---------|----------|----------|
| Number 6, . .                 |         |         |         |         |          |          |
| New 3 (best),                 |         |         |         |         |          |          |
| New 8 (poor-<br>est), . . . . |         |         |         |         |          |          |

It shows that instead of holding true to the character acquired by No. 6 of a slower rate of liquefaction, there was a marked tendency to return to the original quick liquefaction, which could probably alone be overcome by a long course of selection. Notice also the difference in the rate of growth as shown by the fact that the No. 6 finally catches up with the new No. 8, perhaps owing to the approaching exhaustion of the medium.

(2) No. 10 was selected as showing the best effect of reduction of nitrate, being much better than the original culture. It was hoped, by selection, to produce a form which would reduce nitrate as well as normal *B. lactis erythrogenes*. Notice that there was at first a marked tendency to approach the normal type of *B. lactis erythrogenes*. The original culture corresponded in its reducing effect to No. 8 above, whereas eight out of nine of its progeny reduced nitrate better than it did. It was thought that this function might be easily further increased.

Ten colonies were tubed from gelatin plates made from No. 10, and planted in nitrate solution at the same time. Of these it was

found that only three retained the same degree of power of reduction, four fell back to the average of the table given above, while three returned to the condition of the original culture. Here we see again the marked tendency to return to the type, even in this slightly differing race. These results indicate the comparative permanency of the species and also the races of bacteria as stated by Rodet to be the case.

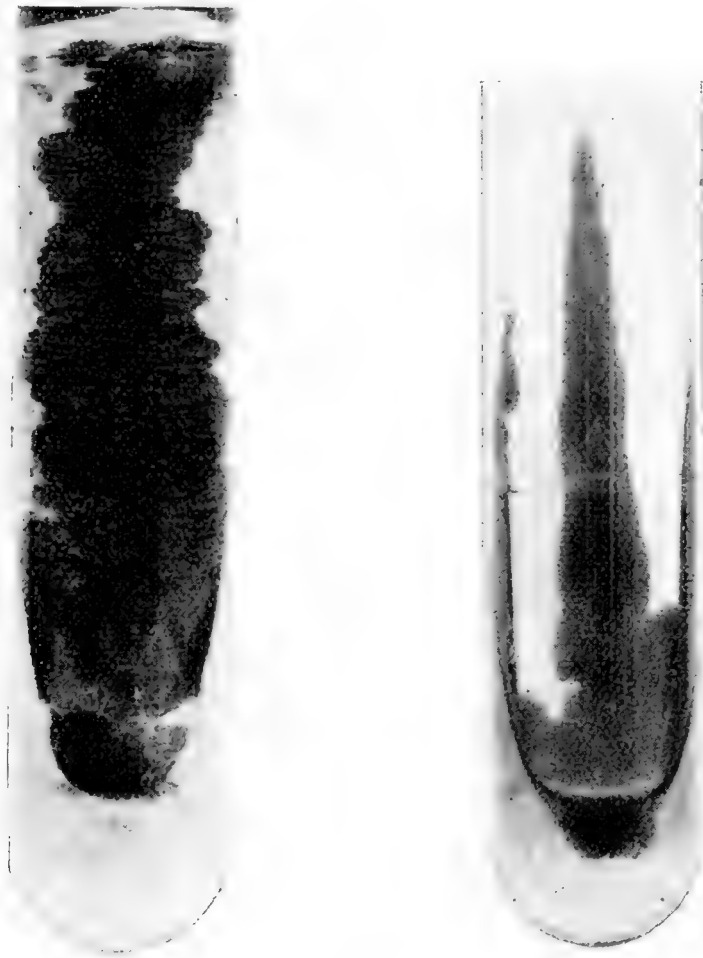
(2) *Sports or discontinuous variations.*

In the discussion of this subject, the existence of uniform conditions is presupposed. I consider that when the tubes are filled with media from the same flask, are planted at the same time, and grown on the same shelf, that these conditions are fulfilled. Or even the plantings need not be made at the same time, provided the conditions of temperature are approximately uniform. We see cultures taken from both deep and surface colonies, from different media, etc., exhibit the same characters when transferred to the test media. Now if one of these suddenly exhibits different characters, it is absurd to attribute the change to the action of some slight, unknown and undemonstrable difference in the medium or other condition. The variation is spontaneous and due to the inherent properties of the germ.

Among the Protista, one objection is always forthcoming against the evidence of discontinuous variation, which does not trouble us higher in the organic scale. It can always be said that the variety may be a contamination, and it is almost impossible to meet this objection completely. Nevertheless, I shall attempt to meet it in the following instance, at least to a considerable degree.

In the species under investigation, *Bacillus lactis erythrogenes*, the growth on solid media is smooth, thick and soft, uniformly light yellow, the growth quite softly granular to the needle, not in the least crusty or viscid. A culture sent to me from Krål's laboratory (marked *B. helvolus* Zimmerman) became contaminated during the summer vacation with a motile spore forming bacillus (*B. mesentericus vulgatus*). In the process of purifying it, gelatin plates were made and a culture from one of the yellow colonies developed a somewhat coarsely granular growth. It was set down as a contamination, although the fact that it produced a slight pink tint in the medium and reacted on all the media nor-

mally for *B. lactis erythrogenes* made me suspect that it might be a variety. Later in the course of the investigation on nitrate reduction on a culture obtained from the air of New York, one of the nitrate tubes showed a growth a little abnormal, the precipitate being slightly flocculent, whereas it is usually finely granular.



*B. ERYTHROGENES RUGATUS.*

*B. LACTIS ERYTHROGENES.*

This nitrate culture was one of ten made from an agar plate of the culture No. 10 as described above. A culture on agar gave a flattened, yellow growth, covered with coarse wrinkles and entirely unlike *B. lactis erythrogenes*. (See figure.) Still all the biological characters were normal, even the peculiar effect on milk, but there



was not a very strong pink tint in the medium. Other agar cultures repeated the characters. Colonies on agar plates were moderately brittle, the surface ones large, flat, and marked with coarse granules centrally, and a rim-like margin. Morphology normal. In short, this form corresponded in all respects with the culture from which it was apparently derived, except in the peculiar alteration in the consistence of the growth mass. But the difference is one that would be usually considered specific.\* Now the usual precautions to avoid contamination were observed here and it is rather unlikely that this culture was a contamination, especially considering the improbability that a contamination should reproduce all the morphological and biological characters so exactly. Moreover, I have seen no such species as this would have to be considered. In spite of these considerations, I am unable to make the assertion that we have not to do with a contamination, but the following experiment occurred to me to test the matter further. I have shown above that there is a tendency for a variety to return to the parent form. Therefore, if this be a variety, some of the colonies should show a return to normal *B. lactis erythrogenes*. If, however, it be a different species accidentally introduced into the original gelatin plate, we should not expect to see any such result. Some agar plates were consequently made and on the third dilution there resulted one hundred and twenty-five large surface colonies, besides many deep ones. Of these one hundred and twenty-five, three showed the smooth surface and soft texture of *B. lactis erythrogenes*. The others were all alike, granular centrally, with a rim-like margin, and liable to crack in two under the needle. Cultures from the former resulted in a normal growth of *B. lactis erythrogenes*, the others reproduced the wrinkly growth. Now there are but two alternatives; either this is a discontinuous variation, which occurs in this species, and which I have thus happened upon in two instances, possessing a certain tendency to return to the type, or there is a species closely allied to *B. lactis erythrogenes*, but differing in texture of growth, which shows a marked tendency to contaminate cultures of this species (!), but is not otherwise common. In my last experiments this "species" must have entered

\* Dr. Prudden has called my attention to the fact that a very similar difference in growth form exists between the *Bacillus tuberculosis* and the *B. tuberculosis gallinarum*.

my nitrate culture, but not entirely overpowered the *B. lactis erythrogenes*, so that both could appear in the plate in the proportions described.

To eliminate this last alternative, plates were again made, this time from a growth taken from one of the rough surfaced colonies just described. This culture has now been through the usual process of purification, and ought not to be contaminated. It exhibited the characteristic wrinkled surface of the form under investigation. Now it is to be remarked that even if no reversion were demonstrable, it would not prove that this form was originally a contamination, for the original tendency to reversion being three out of one hundred and twenty-five, I might have practically eliminated it by this selection. On the other hand, if reversion occurred, it would be evidence in favor of this form being a discontinuous variation. The plates were made with the following result: One third-dilution plate gave about one hundred and fifty surface colonies, all of the wrinkly form; a second third-dilution plate gave about one hundred and forty colonies, three of which were of the normal soft form. Here again the reversion showed itself, but with a distinct tendency to diminution; three out of two hundred and ninety.\* These wrinkly colonies did not reproduce the form of colony described above; they were more folded and wrinkled with uneven edge; but the growth on agar tubes was not noticeably different. In a second "generation" agar culture made from one of these tube cultures when it had become old, a narrow border of the soft growth appeared around the edge, suggesting that either reversion had occurred in the culture itself or that the latter was not pure. Consequently plates were again prepared. The resulting colonies were obtained only few on a plate (about fifty-five surface ones) so as to give them plenty of room. Of these colonies none developed the normal soft form, but when they had become old some exhibited the bordering soft growth just as in the tube from which they were taken, but the border was present in varying degrees. Four cultures were made from different appearing colonies as follows: 1, from a colony all wrinkly, resulting growth all of the wrinkly form; 2, from a colony before definite characters had ap-

\* Notice the much less tendency to reversion in the discontinuous variation than among the slight continuous ones. Is this a general character of these classes of variation?

peared, resulting growth wrinkly with a considerable soft edge; 3, from a deep colony (characters therefore not known), resulting growth about half wrinkly, half soft, mixed; 4, from the smooth border of a colony, resulting growth all of the normal soft form. These results are equally well explicable as the results of contamination as of reversion.

Next plates were prepared from tube No. 1, just described. As no soft border was detected, the growth was presumably, but not positively, of the pure wrinkly form. The resulting colonies were obtained twenty-five on two plates, and consequently well separated. Most of them were of the very wrinkly form with uneven contour and folded surface, and several of these exhibited the soft border in varying degrees. In some it was all around; in others, on one side only, and in one the colony was half soft, half wrinkly. About a quarter returned to the original form of colony with granular surface and rim-shaped margin, and these had no soft borders. No pure normal, soft colonies were seen. The agar tubes made from the very wrinkly colonies and the rimmed-margin ones were scarcely to be distinguished at a casual examination; but a closer observation showed slight differences of the same nature as those between the two forms of colonies. The difference is so slight, however, and so soon becomes obscured by the advance in growth, that I did not notice it previously in the investigation, though it must evidently have obtained.

At this stage of affairs, we have presented the following alternatives: either the variations which I am trying to establish or disprove do occur, or the following condition is operative. It is conceivable that when the skinny growth of the wrinkly form is agitated in sterilized water preparatory to making plates, that on account of its property of coherence, instead of becoming separated into individual cells, certain of which are subsequently to develop colonies, the smallest portions really consist of masses of cells which might entangle a few cells of the smooth form, if this were originally present as a contamination. Thus the resulting colonies might be impure and the apparent phenomena of reversion be due to a separation of this mixture. Now the phenomena described above, of the soft borders to the wrinkly agar cultures and colonies, are in favor of this view, and it was also observed that the growth when shaken up in water disintegrated with great difficulty. On the other hand, the existence at this time of

three different forms, differing only in manner of growth and occurring so sporadically, is much against the contamination theory. Thus it becomes evident that this line of research is not competent to positively exclude the possibility of contamination, though it has rendered it a complicated explanation. It was abandoned at this point.

Now, on the other hand, in making plates of the soft form, the difficulty of the cells possibly adhering in masses is reduced to a minimum. A softer growth is scarcely to be imagined than that of the normal *B. lactis erythrogenes*. In the hanging drop, the cells are seen singly, or, rarely, in pairs or short chains. It is therefore, highly improbable that these should form masses and entangle a few of the wrinkly form. The worst that might be expected would be that the soft and wrinkly forms should adhere in approximately equal numbers, and the resulting colonies could not be mistaken for pure colonies of the soft form. Moreover, whereas a slight growth of the soft form might escape detection in the growth mass of the wrinkly form, it seems almost certain that in the reverse condition the mixture would be easily detected. Taking advantage of these conditions, the question was approached from this side. An agar culture was made from a soft colony occurring on the first "reversion plate" made from the original wrinkly culture. It appeared to be a pure culture of normal *B. lactis erythrogenes*. A pair of third dilution plates prepared from it exhibited about 140 colonies, all of the normal soft form.\* A second pair of plates exhibited 340 colonies, and of these one had returned to the wrinkly form, and gave a typical wrinkly growth on agar; twelve exhibited a new variety, not previously met with, and the rest were of the normal soft form. The new variety possessed a slightly irregular surface, but was soft to the needle. Its growth masses on agar were slightly wrinkly, with the outline finely marked just before the edge as if milled, and altogether were intermediate between the wrinkly form and the normal soft form, but nothing like a mixture of the two. Thus it would seem to be established that these various growths are discontinuous varieties of *B. lactis erythrogenes*,

\* There occurred also on these plates some colonies of *Bacillus ramosus* derived from the sterilized water used in making the plates. The water was boiled just before using as an extra precaution, but the resistant spores of this species were not destroyed.

barring the possibility of some method of contamination which I have not thought to guard against.\*

*Summary of the Variations of Bacillus lactis erythrogenes.*

Form 1. (Normal) Soft, smooth growth in colonies and in tube.

Form 2. Soft and smooth, but the colonies with lobed edges; growth in tube finely creased and milled before the edges.

Form 3. Rather crusty, the colonies even, flat, granular centrally with a well defined rim-like edge; in tubes a flat wrinkled and folded growth with irregular edges.

Form 4. Slightly more skinny than form 3. Colonies and growth on tube alike, very much folded, with irregular edges, tending to produce a margin of the soft form. (See the figure; also the description of No. 107, *B. erythrogenes rugatus*.)

Form 5. There is also to be recorded here the granular variety derived from *B. helvolus*. (See No. 106, *B. helvolus granulatus*.)

Note—These are only variations in the form of growth. All the cultures were of the shade of yellow of the particular form of *Bacillus lactis erythrogenes* from which they were derived, and produced also the pink tint. So far as tested, they reproduced the biological characters of their parent culture, which, as previously noted, were not in all respects normal.

#### EFFECT OF THE ENVIRONMENT.

As an example of the effect of the environment, the action of a change of temperature was selected. It is well known that many chromogenic species, when grown "for several generations" at the body temperature, produce white races, which are more or less permanent. What is the nature of this process?

The same rather pale yellow culture of *Bacillus lactis erythrogenes* was subjected to experiment. The culture No. 6 exhibited a pale growth on agar, especially whitish along the edge. A culture from this edge kept at  $37\frac{1}{2}^{\circ}$  C. for two days, and then transferred to the room temperature, grew nearly white. Three subsequent "generations" treated in the same manner produced

\* Two more sets of plates were made from the last obtained smooth growth, without further reversion; all the colonies were alike. But, as the number of colonies in the two platings was 525 and 1685 respectively, whereas the tendency to reversion was calculated to have diminished at least to 1:950 and 1:1900 respectively, the results are not conclusive against the variation hypothesis.

no further whitening of the growth. It was noticeable that each culture grew less vigorously than the preceding while in the incubator, though it seemed to revive fully when removed to the room temperature. Culture No. 1 was of a distinctly more yellowish shade than No. 6, and not whitish at the edge of the growth. A culture made from it, grown two days in the incubator, and transferred to the room temperature, gave a paler yellow; one from this, about the same tint; the next generation was less uniform, somewhat spotted with white and yellow, and the next generation was distinctly spotted. The same debilitating effects of the repeated exposure to the high temperature was noted here as with No. 6. The last, most spotted (*i. e.*, least yellow) culture was examined as follows:

(1) It was allowed to grow well for several days at the room temperature. It was then seen that the yellow parts of the growth were less active in extending their borders than the white parts were, which resulted in an uneven outline of the growth mass, the yellow fans terminating at the incisions. (2) A set of agar plates was made from this growth. Of the resulting colonies, some were nearly white, others distinctly yellow. It was noted that, on the whole, the yellow colonies were smaller. None of the largest were yellow, though some of the yellow were as large as some of the white ones. (3) Cultures were made from a white and a yellow colony respectively, from one of these plates, and they were planted on milk, nitrate solution and lactose-litmus agar. On all these media the white culture advanced more rapidly than the yellow one; the gelatin was slightly but decidedly more quickly liquefied, the milk more quickly coagulated and the nitrate more strongly reduced in the same time and under identical conditions.

From the above I conclude that the white form is less injuriously affected by the abnormal condition of increased temperature than the yellow form is, and the apparent effect of the temperature in producing a white form in the first instance may have really been due to a process of selection, the white form growing the faster and tending to supplant the other. Thus the ordinary course of transference of a small part of the growth on the inoculation needle would be the agent in this selection. Now it is a fact that the different cultures of *B. lactis erythrogenes* obtained from different sources vary a good deal in tint, and I have indi-

cated that there was some spontaneous variation in this respect in my experimental cultures. The variations toward a white form probably tend to become eliminated under natural conditions where the yellow form doubtless grows best,\* but under the effect of higher temperature there comes room for the action of the selection which I have just described. It may be that this is, at least in great part, the true explanation of the production of the colorless races of chromogenic bacteria, which has been quoted as proof of the "transmission of acquired characters."

#### EFFECTS OF DIFFERENCES IN THE COMPOSITION OF THE MEDIA.

I need not enter into a long discussion of this subject. It is well known that slight variations in the composition of the media make marked changes in the bacterial growth. I have shown elsewhere† the effect of varying degrees of acidity in gelatin; the difference in the action of my selected cultures on the two samples of milk from different sources and with different degrees of acidity, which is tabulated above, is a case in point; again it was noticed that the chromogenic power of some species was less on my media made with meat extract than it was in the same ones grown on media in which the meat itself had been employed.

These changes are not true variations, as they are not inherited; but I have given the exact composition of all the media used in this investigation, to eliminate this source of error. The receipts will be found at the end of the article.

#### CONCLUSIONS AS TO VARIABILITY.

From the above set of experiments I infer that it is premature to assume that races of bacteria are produced by the direct action of the environment. Rather the species possess, first a power of continuous variation, producing intergrading varieties, and which under a long process of natural selection is capable of adapting them to various situations or functions; second, a power of considerable discontinuous variation, producing "sports," dimorphic or polymorphic forms or races (which may revert to type spontaneously; but which are distinguishable from true species only

\* In some old cultures of both the white and yellow forms, which had become partially dried, a few lumps of vigorous growth started out, and these were of the yellow form.

† See Transactions of the New York Academy of Sciences, 1895.

by the occurrence of such revision) and ultimately species, by the lapsing of the capability of reversion.

In the following systematic account, I have provisionally adopted the more conservative course of giving all differing forms specific rank until their exact relations be determined. Many of them will doubtless come to be regarded as races or varieties; some might properly be so placed now.\* Those forms which do not differ except in degree and to no great extent are considered conspecific.

Unfortunately, we do not seem to have arrived at the point where it is possible to differentiate readily species from races and varieties. This results from the fact that there is no standard by which to determine which characters are more reliable. If the several forms be divided on a single character; for example, if we select all yellow species, or all which reduce nitrate or liquefy gelatin, etc., the grouping is different in every instance. There is no indication of the formation of reliable groups by a convergence of the several characters, so that the classification is entirely arbitrary, depending upon which character is given prominence. Consequently, I have as yet found no characters to form a series of natural groups of species under the genus which has been urged on me by Dr. Prudden to be very desirable.

In this paper, the term "groups" has been used in a specific rather than in a subgeneric sense; for instance, the "anthrax group" means a series of forms which are probably varieties of one species; but, as I have given all varietal forms the specific position, I have preferred to use the term as I have, with this explanation.

#### A LIST OF THE COMMON BACTERIA OF THE AIR OF NEW-YORK CITY.

The following list embraces all species found more than once in the air in the course of this investigation. Those occurring but a single time will be referred to in the systematic part. The cultures were obtained by exposing gelatin plates for from one to five minutes in various situations. Of the resulting colonies, a portion only were transferred to tube cultures for investigation. The yeasts, Cladothrices, and moulds were disregarded. In numbers the Micrococci were considerably predominant, but of comparatively few species. The Bacilli, though less common, were

\* For the sake of uniformity this has not been done.



more often of different species, the commonest class being the very short forms, "Microbacilli." No Spirilla were found. Twenty-four Micrococci and forty-four Bacilli were found in the air, and of these the following nine Micrococci and nine Bacilli occurred more than once:

|   |   |
|---|---|
| <i>Micrococcus concentricus</i> , Zimm.           | <i>Bacillus fuscus</i> , Zimm.                  |
| <i>Micrococcus cremoides</i> , Zimm.              | <i>Bacillus finitimus ruber</i> , Dyar.         |
| <i>Micrococcus cremoides albus</i> , Dyar.        | <i>Bacillus decolorans major</i> , Dyar.        |
| <i>Micrococcus pyogenes aureus</i> , Passet.      | <i>Bacillus candicans</i> , Frankland.          |
| <i>Sarcina flava</i> , DeBary.                    | <i>Bacillus inutilis</i> , Dyar.                |
| <i>Micrococcus mobilis</i> , Maurea.              | <i>Bacillus mesentericus vulgatus</i> , Flügge. |
| <i>Merismopedia rosea</i> , Bumm.                 | <i>Bacillus lactis erythrogenes</i> , Dyar.     |
| <i>Micrococcus tetragenus vividus</i> , Dyar.     | <i>Bacillus helvolus</i> , Zimm.                |
| <i>Micrococcus tetragenus versatilis</i> , Stern. |   |

#### SYSTEMATIC ACCOUNT.

I will proceed to detail the morphological and biological characters of all the species which I have worked out in the course of this investigation.\* I have prepared synoptic tables, so that all of these species can be readily and quickly identified. The composition of all the media of cultivation made use of is given at the end of the systematic account. As far as possible, previously used media have been employed, and the most often used of these have been given prominence (though they do not always deserve it from the point of view of reliability) in order to bring in line the work already recorded by others in description of species. My work has mainly consisted in the general application of a series of tests uniformly to a rather large group of species, and the result in the manner of their separation seems, on the whole satisfactory. If this work could be extended to cover all the species of Bacteria, I think the operation of identifying species would be far less confusing than it is at present. An objection which I have not been able to overcome is the great length of

\* This includes all those planted for comparison as well as those derived from the air.

time necessary to determine a species. I have felt obliged to use the action on gelatin as the primary character, because it has been the only medium in general use; but I find it necessary to grow cultures at least two months before becoming certain that liquefaction will not ultimately ensue. To the other media, I have set the limit of twenty-eight days. All cultures were grown at the room temperature, unless otherwise stated.

In the Mircococci I have used the terms Merismopedia and Sarcina in the generic form to indicate the general mode of association of the elements; but I do not wish them to be understood as of true generic value. They are, in some instances, of less than specific value; but they are convenient terms, and I have used them as such. It is to be hoped that further study will develop some reliable practical morphological characters which will enable us to divide the two unwieldy genera, Micrococcus and Bacillus, in a satisfactory manner. The mode of association of the elements is not such a character,\* the opinions of Drs. Helme and Raugé to the contrary notwithstanding.

In several instances I have not been able to differentiate species occurring in the air and presumably saprophitic, from pathogenic parasites, and I am led to the conclusion that the pathogenic property is not in all cases a test of specific difference, but rather a varietal or racial character. The bearing of this conclusion on the classification adopted in Eisenberg's "Bakteriologische Diagnostik" should be noted.

The characters used in the table will be self-explanatory for

\* The mode of association of the elements is not a satisfactory generic character, because the differences between Micrococcus, Diplococcus, Merismopedia and Sarcina may be due solely to differences in the degree of the coherence of the cells. They may also arise from actual differences in the manner of multiplication, it is true, as follows:

(1) Cells dividing in only one plane, forming Micrococcus, Diplococcus, Streptococcus,

(2) Cells dividing in two planes, forming Micrococcus, Diplococcus, Merismopedia.

(3) Cells dividing in three planes, forming Micrococcus, Diplococcus, Merismopedia and Sarcina.

But this theoretical difference remains to be demonstrated, I think, between the last two, and it is certainly so obscure a one in practice as to warrant the above remarks. At best these characters give but three genera instead of five or six. Streptococcus is not included in this paper, and my species may be all Sarcinæ with a greater or less tendency to break up into single cells.

the most part when the media used are taken into account. Gelatin is to be regarded as liquefied even when the fluid evaporates as fast as formed and only a dry hollow results. Consequently, if any hollow is formed by the growth mass, the gelatin is to be considered liquefied.

In the descriptions I have not repeated the characters given in the synoptic table except where necessary to enlarge on them.

#### THE CHARACTERS FOR WHICH THE SEVERAL MEDIA ARE USED.

It is important that the number of media should not be unnecessarily multiplied, or else the labor of determining species will become too great. The following shows the characters which I have obtained from the several media used, and how labor may be saved in some instances :

*Broth.* This medium may usually be omitted. The characters to be obtained from it are good ones, but can usually be detected as well in the fermentation tube and water of condensation in the agar cultures.

*Gelatin.* Only used for the liquefaction test and the characters of colonies on plate. I have found it practicable to dispense with a separate planting on simple gelatin by preparing a lactose-litmus gelatin, which combines the characters of liquefaction and acid or alkali formation in one medium. I have disregarded the decolorizing effect on litmus so often seen, as I have not found the characters reliable on solid media.

*Agar.* Used for the growth forms and necessary. Glycerine agar is less important, and I have not used it for diagnostic purposes.

*Fermentation broth* in bent tubes is necessary for the gas formation test and relation to air. The gas formation is often indicated on lactose-litmus gelatin, and in such cases scarcely needs confirmation on this medium.

*Milk* for the effects of coagulation. It should always be boiled before the test can be considered complete.

*Nitrate solution.* The test for nitrates may be applied by adding two to five drops of naphthylamine sulphate, a small crystal of sodium sulphanilate and boiling the medium to hasten the reaction. When cool it is ready to examine for the color. I do not test for ammonia.

*Rosolic acid broth.* Useful for decolorization effects. The deepening of the tint is of little value.

*Pepton and salt broth.* For the formation of indol. The test may be applied by adding a few drops of sulphuric acid, and then a very dilute sodium nitrite. Care should be exercised not to add too much. This test is open to the same objection as is the nitrate test, and in greater degree, in that the characters to be obtained from it are not sharp ones.

## BACTERIOLOGICAL DIAGNOSIS.

*Species which will grow on the ordinary media, in presence of air at 20° C.*

### MICROCOCCI.

The gelatin is not liquefied . . . . . page 345

The gelatin is ultimately liquefied . . . . . page 348

### BACILLI.

No gas formed in the fermentation tube.

The gelatin is not liquefied . . . . . page 355

The gelatin is ultimately liquefied . . . . . page 364

Gas is formed in the fermentation tube . . . . . page 375

### SPIRILLA (not found in the air).

*Species which are anaerobic, will not grow on the ordinary media, or require a higher temperature than 20° C. (not investigated).*

## NON-LIQUEFYING MICROCOCCI.

(Synopsis of species).

Lactose-litmus gelatin reddened.

Chromogenic.

Yellow ; nitrate strongly reduced . . . . . 1

Red ; nitrate very slightly reduced . . . . . 2

Not chromogenic.

Milk coagulated.

Nitrate slightly reduced; milk coagulated . . . . . 3

Nitrate not reduced . . . . . 4

Milk not coagulated.

Growth on agar opaque white . . . . . 5

Growth on agar thin, transparent, poor . . . . . 6

Lactose-litmus gelatin made blue.

Nitrate not reduced; milk not coagulated.

Rosolic acid faded . . . . . 7

Rosolic acid not changed

Chromogenic; orange . . . . . 8

Not chromogenic; white . . . . . 9

Nitrate reduced; milk not coagulated.

Not chromogenic; white . . . . . 10

Chromogenic; red . . . . . 11

**1. *Merismopedia flava varians* n. sp.**

*Occurrence.* Abundantly in a jar of "sterilized milk" bought at a store; with no. 101.

*Morphology.* Micrococci about  $1\ \mu$  in diameter, in twos, fours or in elliptical pairs with a cross-furrow.

*Biology.* Gelatin not liquified in 60 days; milk coagulated on boiling in 6 days, more evidently later, but not without boiling; nitrate quickly and strongly reduced even in 7 days; lactose-litmus quickly reddened, but in 50 to 60 days it becomes blue at the upper part of the culture; aerobic. In broth there is a fine turbidity and considerably granular yellow sediment; on the solid media a broad pale yellow layer is developed, which may vary in shade, even in different parts of the same culture; on glycerin-agar and potato the growth is abundant, shining bright yellow, opaque. In gelatin plates the surface colonies are much larger than the deep ones, opaque, scarcely shining, light yellow, the edges a little wavy; the deep colonies are round, opaque, yellow, inclined to be slightly irregular.

**2. *Merismopedia cinnabareus* (Flügge).**

*Occurrence.* In the air of the College hallway.

*Morphology.* Micrococci about  $1\ \mu$  in diameter, in twos, fours or in elliptical pairs with a cross-furrow.

*Biology.* Milk is not coagulated at first, but in twenty-one days a soft cheese is formed which boils up into a very fine coagulum scarcely perceptible.

Nitrate is only very slightly reduced in twenty-eight days. Rosalic acid is not changed. On agar, the growth is not abundant, brownish red, almost orange. Gelatin colonies are all alike, round, orange colored.

*Remarks.* I may be mistaken in identifying this as Flügge's species (*Micrococcus cinnabareus*).

**3. *Micrococcus candicans* (Flügge).**

*Occurrence.* A culture from Krål's laboratory.

*Morphology.* Micrococci  $1-1.25\ \mu$  in diameter, singly, in pairs or groups.

*Biology.* Milk was not coagulated when the culture was first received. A year later a coagulation was formed on boiling at the end of twenty-six days; again a solid curd was formed in this time. Nitrate is slightly reduced, the test giving a faint color in twenty-eight days. The growth is white and opaque on solid media, no surface growth in liquid media. Surface colonies are thin, the deep ones round and opaque, white. Rosolic acid is not changed.

**4. *Micrococcus rosettaceus* (Zimmermann).**

*Occurrence.* "Micrococcus aurantiacus" from Krål's laboratory.

*Morphology.* Micrococci  $.7-.8\ \mu$  in diameter, associated in masses.

*Biology.* Milk is coagulated (on boiling) in fourteen days, and does not change up to twenty-eight days. Growth on solid media is shining white, opaque, soft; no surface growth on broth. Rosolic acid unchanged.

*Remarks.* This is nearest to *M. rosettaceus*, though perhaps not identical.

5. **Merismopedia tetragenus** (Gaffky).

*Occurrence.* "Micrococcus tetragenus" from Krål's laboratory.

*Morphology.* Micrococci .7-.8  $\mu$  in diameter, in pairs, a few fours and irregular groups.

*Biology.* Besides the character given in the synopsis, rosolic acid is not changed; on solid media the growth is opaque white; no surface growth on broth.

6. **Micrococcus similis** n. sp.

*Occurrence.* In the air of the college hallway.

*Morphology.* Large cocci, never quite spherical, and frequently divided by a constriction to one side of the middle. Very variable, diameter 1-2  $\mu$ . The cells are larger than the *Bacillus diphtheriae* and decidedly rounder, more like cocci.

*Biology.* Grows very poorly at all temperatures. On agar the growth is obscure, narrow, translucent whitish. On the lactose-litmus agar there is faint growth with a slight reddening of the medium; rosolic acid is not faded. The gelatin colonies are round, opaque white, uncharacteristic. There is little reduction of nitrate, especially marked 37½° where a distinct test was obtained in twenty days.

7. **Micrococcus concentricus** (Zimmerman).

*Occurrence.* (1) "M. concentricus" from Krål's laboratory. (2) Eighteen different times in the air of the college hallway.

*Morphology.* Micrococci .6-1.2  $\mu$  in diameter, singly, in twos, in short irregular chains or in masses.

*Biology.* Well distinguished by its power of decolorizing rosolic acid. The growth on solid media is rather translucent white, sometimes concentrically marked. On liquid media the growth is soft and somewhat stringy, often forming around the surface on the glass. Growth on potato abundant, shining sordid white.

8. **Micrococcus cereus aureus** n. sp. ?

*Occurrence.* (1) "Staphylococcus\* cereus aureus" from Krål's laboratory. (2) A contamination from the air of the laboratory.

*Morphology.* Cocci .7-.8  $\mu$  in diameter, singly, in pairs, threes or masses.

*Biology.* On agar and potato shining bright orange. In broth a heavy orange colored sediment with no surface growth.

*Remarks.* I have seen no description with the above name, under which the culture was received. This is only a variety of the following species, which is the non-chromogenic form.

9. **Micrococcus cereus albus** (Passet).

*Occurrence.* (1) "Staphylococcus cereus albus" from Krål's laboratory. (2) In the air on 59th St.

\*Of all the generic terms proposed for the various associations of the cocci, probably "Staphylococcus" is the least valuable. I would definitely discard it.

*Morphology.* Micrococci 1–1.5  $\mu$  in diameter, often seen constricted for division, singly or irregularly grouped.

*Biology.* The growth on solid media is white, not very opaque ; a white sediment in broth ; rosolic acid not changed. The gelatin colonies are round, uncharacteristic, the deep and surface ones much alike.

10. **Merismopedia ceriviseae** (Balcke).

*Occurrence.* (1) “*Sarcina flava*” from Krål’s laboratory. (2) In the air of the college hallway.

*Morphology.* Micrococci .7–1.5  $\mu$  in diameter, singly, in pairs, rarely in fours, in masses.

*Biology.* Nitrate is strongly reduced, the full deep color of the test being shown in from six to fourteen days ; rosolic acid unchanged. In broth, a granular precipitate. On solid media the growth is white or very faintly yellowish (2), moderately opaque.

*Remarks.* These cultures seem not to be contradicted by the description of *Pediococcus ceriviseae*.

11. **Merismopedia havaniensis** (Sternberg).

*Occurrence.* (1) From the college collection. (2) In the air of the college yard near 59th St.

*Morphology.* Micrococci, slightly elliptical, often with cross furrows. .7–1  $\mu$  in diameter, in twos, fours, or breaking apart into irregular chains.

*Biology.* Nitrate is slightly reduced, never strongly ; growth on solid media is red and a fine red surface growth occurs on milk without affecting the medium preceptibly ; a granular precipitate in broth.

*Remarks.* This is the *Bacillus havaniensis* of Sternberg ; but I have preferred to associate it with the Micrococci on account of the grouping of the elements.

LIQUEFYING MICROCOCCI.

(Synopsis of species).

Lactose-litmus reddened.

Milk coagulated ; nitrate not reduced.

Large Micrococci, growth on agar lobed.

Growth orange colored ..... 12

Growth cream colored ..... 13

Growth white ..... 14

Smaller Micrococci, growth normal.

Associated in masses.

Growth orange ..... 15

Growth white.

Quickly liquefying .... 16

Slowly and imperfectly liquefying ..... 17

Associated in pairs and fours ..... 18

Milk not coagulated.

Nitrate not reduced.

|   |    |
|---|----|
| Growth yellow.                                  |    |
| Large Micrococci .....                          | 19 |
| Minute Micrococci.....                          | 20 |
| Growth pinkish thin .....                       | 21 |
| Nitrate reduced . . . . .                       | 22 |
| Lactose-litmus not changed or made blue.        |    |
| Milk coagulated.                                |    |
| Growth orange.....                              | 23 |
| Growth yellow.....                              | 24 |
| Growth white .....                              | 25 |
| Milk not coagulated.                            |    |
| Motile.   |    |
| Orange .....                                    | 26 |
| Pink .....                                      | 27 |
| Not motile.                                     |    |
| Orange .....                                    | 28 |
| Pink .....                                      | 29 |
| Yellow.   |    |
| Growth granular, a normal precipitate in broth. |    |
| Bright lemon yellow.....                        | 30 |
| Paler yellow.....                               | 31 |
| Pale creamy yellow.....                         | 32 |
| Growth forming surface skin, wrinkly.....       | 33 |

12. **Micrococcus cremoides aureus** n. sp.

*Occurrence.* Obtained by Dr. Freeman from the air of a barn where a cow was being milked.

*Morphology.* Micrococci 1-1.25  $\mu$  in diameter, associated irregularly.

*Biology.* Gelatin is rapidly liquefied; the surface colonies on gelatin plates are somewhat peculiar; in the cups of liquefaction which are quickly formed, masses of opaque orange flocculi settle in a ring shape about a clear central area, giving the appearance of an indented margin. Liquefaction sets in much later with the deep colonies. They appear spherical, light yellow and opaque. Milk is quickly coagulated, forming a solid curd which is slowly dissolved. Rosolic acid not changed. Lactose-litmus is quickly reddened. The growth on agar is narrow, shining, the edges uneven, finely lobed, orange color. The lobed edges are rather characteristic. On glycerine agar the growth is scarcely chromogenic, being very nearly white, but the normal color is regained when transferred to ordinary agar. At 37½° C. also the growth is not chromogenic. In broth there is a slight surface growth beside a pale orange sediment.

*Remarks.* This species is to be regarded as a varietal form of the following:

13. **Micrococcus cremoides** (Zimmermann).

*Occurrence.* (1) In the air of the college hallway. (2) In the air on 59th St.

*Morphology* and biology as in No. 12, but the growth cream-colored instead of orange. On glycerine agar and at 37½° C., the growth is white.



*Remarks.* This seems to correspond with *M. cremoides* of Zimmermann, except that the cells are larger. *Cremoides* is said to measure  $.8\mu$ , while the present species measures  $1-1.5\mu$ .

14. **Micrococcus cremoides albus** n. sp.

*Occurrence.* (1) Twice in the air of the college hallway. (2) Twice in the air of the yard near 59th St.

*Morphology* and biology as above (Nos. 12 and 13), but the growth pure white on all media.

*Remarks.* This is a white form of the preceding.

15. **Micrococcus pyogenes aureus** (Passet).

*Occurrence.* (1) "Staphylococcus pyogenes aureus" from the college collection. (2) Twice in the air of the yard near 59th St.

*Morphology.* Micrococci  $.7-1\mu$  in diameter, associated in irregular masses.

*Biology.* Gelatin quickly liquefied; milk coagulated, forming a hard curd which is slowly dissolved; nitrate not or very slightly reduced. Growth on solid media orange, the edges of the growth even. In gelatin plates the colonies sink in cups of liquefaction without any peculiar appearance. Culture (1) was chromogenic on glycerine agar and at  $37\frac{1}{2}^{\circ}\text{C}$ ; the one first obtained from the air was chromogenic at  $37\frac{1}{2}^{\circ}\text{C}$ , but grew nearly white on glycerine agar and the third culture grew white in both these cases. Rosolic acid not changed.

16. **Micrococcus pyogenes albus** (Passet).

*Occurrence.* In the air of the college hallway.

*Morphology* and biology as above, but the growth is white, on agar rather translucent.

*Remarks.* This is probably to be regarded as not specifically distinct from the preceding.

17. **Micrococcus epidermidis albus** (Welch).

*Occurrence.* (1) "Staphylococcus epidermidis albus" from the college collection. (2) "Micrococcus of Freire" from the college collection. (3) In the air on 59th St.

*Morphology* and biology as above, but gelatin is very imperfectly liquefied. The liquefaction begins in about six days, but proceeds very slowly, and never far; even in old cultures it is only partial.

*Remarks.* In the description of *Micrococcus* of Freire, Dr. Sternberg states that milk is not coagulated, but this was not the case with the authentic culture possessed by the college. It reacted in all ways as given in the synopsis and as indicated above.

18. **Merismopedia acidi lactici liquefaciens** (Kreuger).

*Occurrence.* (1) "Micrococcus ureae" from Krål's laboratory. (2) "Sarcina erythromyxa" from Krål's laboratory.

*Morphology.* Micrococci  $.9-1.1\mu$  in diameter, singly, in twos or in fours.

**Biology.** Gelatin is quickly liquefied but in (2) proceeded slowly and was not complete. Milk is coagulated, forming a solid curd, but in (2) only so on boiling. Nitrate very slightly reduced; rosolic acid unchanged. Growth on solid media opaque white; in broth, a white precipitate with a slight growth at the surface or on the side of the tube. Grows well at  $37\frac{1}{2}^{\circ}$  C.

**Remarks.** I see no essential differences between the descriptions of *Micrococcus acidilactici liquefaciens* Kreuger, *Micrococcus ureae liquefaciens* Flügge, or *Sarcina alba* Eisenberg, to either of which the present species might be referred. It does not belong to either of the species under the names of which it was sent to me.

#### 19. *Micrococcus flavus liquefaciens* (Flügge).

**Occurrence.** In the air of an apartment house on West 69th St.

**Morphology.** Large spherical Micrococci,  $1-1.25\ \mu$  in diameter, singly, in pairs or irregular groups.

**Biology.** Liquefaction of the gelatin takes place very slowly. When first obtained, it ensued in ten days, but proceeded very slowly. After the culture had been kept a year, liquefaction was not obtained until the two cultures which had been made had been growing twenty-eight and fifty days respectively. A very slight reduction of nitrate was obtained in twenty-eight days, none before that time. Growth on solid media, white at first, later becoming pale yellow. Growth on glycerine agar and at  $37\frac{1}{2}^{\circ}$  C. is white, but in the latter case the yellow color is regained on being transferred to the room temperature.

**Remarks.** This differs a little from Flügge's species with which I have identified it, but apparently only in liquefying gelatin more slowly and being less chromogenic. No growth was obtained on potato.

#### 20. *Micrococcus flavus desidens* (Flügge).

**Occurrence.** In the air of an apartment house on West 69th St.

**Morphology.** Small Micrococci,  $.6-.7\ \mu$  in diameter, in irregular groups.

**Biology.** As indicated in the synopsis. The liquefaction of gelatin is very slow and only appears in old cultures (first seen in fifty-six days). A partial reduction of nitrate is obtained in twenty-eight days. On solid media the growth is lemon yellow, rather thin, poor on glycerine agar; on potato slight growth, yellowish, but the potato assumed a pink tint.

**Remarks.** It differs from the species with which I have identified it in liquefying gelatin much more slowly.

#### 21. *Merismopedia fragilis* n. sp.

**Occurrence.** In the air on 59th St.

**Morphology.** Micrococci  $1-1.2\ \mu$  in diameter, in twos, fours and irregular groups but scarcely forming well defined packets.

**Biology.** Gelatin liquefied rather slowly, but beginning in six days; characters all negative except the reddening of lactose-litmus, and this is not of a very pronounced character. Growth on agar poor, thin, translucent, pink-

ish, consisting of a number of isolated colonies, each spreading with a veil. In gelatin the growth along the punctures is white, the surface growth sinks slowly in the liquefaction as a pinkish sediment. On glycerine agar the growth is abundant, thick, smooth and of a reddish brown color. Scarcely any growth on potato; no growth at the body temperature.

## 22. *Merismopedia citreus conglomeratus* (Bumm).

*Occurrence.* In the air of the college hallway.

*Morphology.* Micrococci  $.9\mu$  in diameter, singly, in twos, rarely in elliptical pair with a cross furrow.

*Biology.* Gelatin liquefied quickly at first (six days), but in latter cultures not till forty-five days; nitrate reduced, partially at first, but in twenty-eight days completely. Gelatin plate colonies are at first white, opaque, very strongly cumular and lobed; they are unusually coherent and will flow around in the liquefied medium with unaltered shape. On agar the growth is white at first, later distinctly pale yellow, granular and lumpy, somewhat brittle and crusty to the needle. Rosolic acid is rendered a little brownish but not distinctly faded.

*Remarks.* This does not tally exactly with Bumm's description of *Diplococcus citreus conglomeratus*, but I find no positive points of difference.

## 23. *Merismopedia mollis* n. sp.

*Occurrence.* As a contamination from the air of the laboratory.

*Morphology.* Micrococci, sometimes a little elongate, about  $1\mu$  in diameter, singly, in pairs and a few fours, in irregular chains of four to six and in masses.

*Biology.* Gelatin quickly liquefied; milk coagulated, the precipitated casein forming a curd which is gradually dissolved. Nitrate partly reduced. Lactose-litmus and rosolic acid unchanged. Growth on agar abundant, shining orange color.

## 24. *Sarcina flava* (De Bary).

*Occurrence.* (1) "*Sarcina ventriculi*" from the college collection. (2) Four different times in the air of the college hallway. (3) In the air in West 59th St. (4) Twice as a contamination from the air of the laboratory on gelatin plates. (5) In a fresh leaf of the pitcher plant, *Sarracenia purpurea*, at Plattsburgh, N. Y., in June.

*Morphology.* Micrococci about  $1\mu$  in diameter associated in cubical packets of eight and larger bundles, rarely breaking up into fours.

*Biology.* Gelatin usually quickly liquefied, more rarely slowly liquefied; milk coagulated, the precipitated casein forming a curd which is gradually dissolved. Nitrate not reduced or but a trace. Lactose-litmus made blue; rosolic acid not changed. Growth on agar abundant, thick, not very shining, yellow; on glycerine agar very abundant, shining bright yellow. At  $37\frac{1}{2}^{\circ}\text{C}$  the growth is white, but largely regains its yellow color on being transferred to the room temperature.

*Remarks.* I find no characters to separate *Sarcina lutea* Schröter from this species. It appears to liquify gelatin more slowly; but the cultures before me vary greatly in this respect. One produced only a dry cup-shaped hollow in twenty-eight days, from which the fluid at first formed had evaporated. The more usual form rendered the upper one-third or two-thirds of the gelatin fluid in twenty-eight days.

**25. *Micrococcus dissimilis* n. sp.**

*Occurrence.* : "Micrococcus of trachoma, Sattler" from Král's laboratory.

*Morphology.* Micrococci  $1\mu$  in diameter, associated in irregular masses.

*Biology.* Gelatin quickly liquefied; milk coagulated, forming a flaky curd with milky whey; nitrate reduced, but not thoroughly before twenty-eight days; lactose-litmus and rosolic acid unchanged; opaque white on agar, not viscid; surface colonies round, opaque, like deep ones but surrounded by an obscure granular veil; no surface growth on broth. No growth on potato.

*Remarks.* This does not agree with the description of the *Micrococcus* of trachoma.

**26. *Micrococcus mobilis* (Maurea).**

*Occurrence* (1) Twice in the air of the college hallway. (2) Twice in the air on 59th St.

*Morphology.* Micrococci  $1-1.5\mu$  in diameter, singly, rarely in pairs. Each cell possesses a single long flagellum which may be demonstrated by Löffler's method of staining; actively motile.

*Biology.* Gelatin quickly liquefied, or, in one instance, slowly and imperfectly; rosolic acid not changed. On agar the growth is translucent, obscure, where collected in a thicker layer reddish orange. On glycerine agar and at  $37\frac{1}{2}^{\circ}$  scarcely any growth occurs; growth on potato very slight, pale orange. In absence of free access of air, the growth is whitish.

*Remarks.* I take this to be the *Sarcina mobilis* of Maurea.

**27. *Micrococcus agilis* (Ali-Cohen).**

*Occurrence.* From the college collection.

*Morphology* and *biology* as above (No. 26), but the growth is pink instead of orange color and is thicker and more opaque on agar.

**28. *Sarcina aurantiaca* (Koch).**

*Occurrence.* (1) From the college collection. (2) In the air of the college hallway.

*Morphology.* Micrococci  $.8-1.2\mu$  in diameter, in twos, fours, and masses, occasionally forming true packets.

*Biology.* Gelatin quickly liquefied (1) or slowly and imperfectly (2). Nitrate not reduced, or a slight trace of reduction. On agar the growth is dark orange colored, not very shining. Rosolic acid not changed. In broth no surface growth, the sediment yellowish or white.

29. ***Merismopedia rosea*** (Bumm).

*Occurrence.* (1) "*Sarcina rosea*" from the college collection. (2) "*Micrococcus tetragenus ruber*" from Král's laboratory. (3) Twice in the air of the college hallway. (4) In the air of an apartment house on West 69th St. (5) A contamination from the air of the laboratory.

*Morphology.* Micrococci .7-1  $\mu$  in diameter, in twos, fours and irregular groups.

*Biology.* Gelatin is very slowly liquefied, often not at all for thirty or forty days. Some cultures liquefy more readily after having been in cultivation for some time. Nitrate is partly reduced, sometimes quite well, never completely. Rosolic acid not changed. Growth on solid media rose pink, the color being somewhat absorbed by the medium in old cultures. No surface growth on broth.

*Remarks.* I have identified this as the *Diplococcus roseus* of Bumm. *Micrococcus roseus* Eisenberg, and *Micrococcus tetragenus ruber* Schneider seem to refer also to this species.

30. ***Micrococcus tetragenus vividus*** n. sp.

*Occurrence.* (1) Four times in the air of the college hallway. (2) In the air of an apartment house on West 69th St. (3) From the air of one of the lecture rooms (Dr. Cheesman).

*Morphology.* Small Micrococci .5-.9  $\mu$  in diameter, singly, in twos, threes or irregular groups, rarely in fours.

*Biology.* Gelatin is liquefied with moderate rapidity, or rather slowly; nitrate not or very slightly reduced. Growth on solid media vivid lemon yellow; in broth a heavy yellow sediment without surface growth.

*Remarks.* Dr. Sternberg has included both this form and no. 32 in his description of *Micrococcus tetragenus versatilis*, but I have preferred to give them distinctive names, following the general system adopted here.

31. ***Micrococcus tetragenus versatilis*** (Sternberg).

*Occurrence.* (1) "*Micrococcus tetragenus versatilis*" from the college collection. (2) "*Micrococcus tetragenus flavus*" from Král's laboratory. (3) Five times in the air of the college hallway. (4) In the air on 59th St.

*Morphology* and *biology* as in no 30, but the growth is paler yellow of a more normal tint, not unusually bright.

32. ***Micrococcus tetragenus pallidus*** n. sp.

*Occurrence.* In the air of one of the college lecture rooms (Dr. Cheesman).

*Morphology.* Micrococci .8-1  $\mu$  in diameter, in twos, more commonly in fours, occasionally in irregular packets.

*Biology.* As in Nos. 30 and 31, but the growth is pale creamy yellow, approaching white.

33. **Merismopedia mesentericus corrugatus** n. sp.\*

*Occurrence.* "Staphylococcus pyogenes citreus" from the college collection.

*Morphology.* Micrococci .9  $\mu$  in diameter, associated in great adherent masses more or less packeted, breaking apart into twos or single elements.

*Biology.* Gelatin is quickly liquefied. On agar, the growth spreads rapidly, and becomes covered with a few large wrinkles or folds, traversing the surface in various directions; the color is yellow. On broth, a thick and wrinkled yellow surface skin is formed with a slight yellow sediment in the bottom.

NON-LIQUEFYING BACCILLI.

(Synopsis of species.)

Lactose-litmus reddened.

Nitrate not reduced.

Milk coagulated ..... 34

Milk not coagulated.

Actively motile, a green fluorescence..... 35

Not motile or spasmodically only.

Small bacilli..... 36

Very large vacuolated..... 37

Nitrate reduced, at least partially.

Milk coagulated.

Lactose-litmus permanently reddened, growth white..... 38

Lactose-litmus reddened, later blue, growth sometimes faintly  
ocherous..... 39

Milk not coagulated.

Growth yellow, nitrate completely reduced..... 40

A green fluorescence ; nitrate partly reduced..... 41

Pale yellow, nitrate slightly reduced..... 42

Lactose-litmus made blue.

Nitrate reduced, at least fairly well ; milk not coagulated.

Growth dark yellow..... 43

Growth pale yellow ..... 44

Growth white.

Grows well at room temperature.

Rosolic acid faded..... 45

Rosolic acid not faded.

Not motile..... 46

Actively motile.

Growth thin, transparent..... 47

Growth moderately opaque..... 48

Scarcely grows at room temperature..... 49

\* Compare with this No. 107, *Bacillus erythrogenes rugatus*. The biological characters of the two are practically alike. No. 33 was determined as a Micrococcus, and No. 107 as a Bacillus; but it is one of the shortest bacilli known, so that the differences between these forms are really slight. No. 33 was not observed to form any pink color ; but this is not an invariable character of the *lactis erythrogenes* group.

Nitrate not reduced or not more than very slightly.

Chromogenic.

Motile ; a green fluorescence.

Rosolic acid decolorized..... 50

Rosolic acid not changed.

Growth white. .... 51

Growth yellow ..... 52

Not motile.

A crusty skin on broth more or less complete.

Orange red..... 53

Pale whitish orange..... 54

Slightly crusty, brick red ..... 55

No crusty skin.

Salmon pink, pale along puncture..... 56

Reddish pink, white along puncture..... 57

Pink, white along puncture..... 58

Bright orange ..... 59

Yellow ..... 60

Not chromogenic.

Rosolic acid decolorized.

Culture viscid ..... 61

Culture soft ..... 62

Rosolic acid not changed.

Growth very feathery, especially in gelatin..... 63

Growth not feathery, normal.

Motile ; growth white, rather opaque.

Rather large bacilli (about  $.8 \times 1.5 \mu$ )..... 64

Smaller bacilli (about  $.5 \times 1 \mu$ )..... 65

Not motile.

White, rather opaque . . . . . 66

Misty, concentric, not opaque..... 67

Very thin, transparent..... 68

#### 34. ***Bacillus crassus sputigenus***. (Kreibohm).

*Occurrence*. From the college collection.

*Morphology*. Short, or moderately long rounded bacilli,  $.7 \times 1-2 \mu$ , singly, or more commonly in short chains of two to three elements ; not motile.

*Biology*. As indicated in the synopsis. Milk was not coagulated till twenty-eight days and then only on boiling.

#### 35. ***Bacillus virescens*** (Frick).

*Occurrence*. " *Bacillus* of green diarrhoea " from the college collection.

*Morphology*. Small rounded bacilli,  $.7 \times 1-2 \mu$ , singly or in moderately long straight chains ; actively motile.

*Biology*. A partial surface skin is formed on liquid media. In the fermentation tube, abundant growth occurs in the open arm, but it also extends well up into the closed arm. Growth on agar white, rather translucent,

a green fluorescence in the medium. Lactose-litmus is reddened rather slowly; but ultimately completely.

*Remarks.* From the description, this culture can be referred to either *B. fluorescens tenuis* Zimmerman, *B. virescens* Frick, or *B. dentalis viridans* Miller. The "Bacillus of Lesage" (green diarrhoea) is said to produce slow liquefaction. It differs from No. 41 only in that nitrate is not reduced.

36. **Bacillus sarracenicolus** n. sp.

*Occurrence.* In a fresh leaf of the pitcher plant (*Sarracenia purpurea*) at Plattsburgh, N. Y., in June.

*Morphology.* Small bacilli, surrounded by clear spaces in the stained preparation, not motile; in pairs, short chains or singly; size about  $.5 \times 1 \mu$ .

*Biology.* Growth on agar, white, faintly tinged with brownish, spreading; when old, almost ocherous; on lactose-litmus gelatin the growth spreads out into long lobes, the litmus is reddened, but the color begins to disappear in forty days, and the medium is purple or bluish in ninety days.

37. **Bacillus vacuolatus** n. sp.

*Occurrence.* Two cultures from a trap of the carnivorous water plant *Utricularia vulgaris* from Dead Creek, Plattsburgh, N. Y., in September.

*Morphology.* Large bacilli varying greatly in length, about  $1 \mu$  wide and  $1-5 \mu$  long, the ends rounded; the contents are curiously vacuolated both in fresh and old cultures, so that the bacilli stain irregularly, but usually well at the ends; singly or in short chains; usually not motile, but occasionally spasmodically so. Looks like the figure of *Bacillus buccalis maximus*, Miller.

*Biology.* On agar shining, soft translucent white. Lactose-litmus gelatin is reddened, but in about sixty days this color begins to be replaced by blue which gradually increases, though the red was still visible at the apex of the slant in ninety days.

38. **Bacillus ureæ** (Jaksch).

*Occurrence.* (1) "Bacillus ureæ" from Krål's laboratory. (2) "Bacillus pyogenes foetidus" from Krål's laboratory.

*Morphology.* Short rounded bacilli  $.7-1 \times 1-2 \mu$ , not motile, singly or in short chains.

*Biology.* Nitrate partially reduced, the test giving a moderate color; milk coagulated in (2) only on boiling. Growth on agar, broad shining sordid white, not very opaque; no surface growth on broth; rosolic acid unchanged. A considerable amount of indol is formed in peptone-salt broth.

*Remarks.* Appears not to be contradicted by the description of *Bacterium ureæ* of Jaksch. Comes near *Bacillus ubiquitus* Jordan, but possesses much less power of reducing nitrate.



39. **Bacillus subochraceus** n. sp.

*Occurrence.* In the air of the college hallway.

*Morphology.* Rather small bacilli,  $.7 \times 1.5 \mu$ , not motile or spasmodically so, singly or in short chains.

*Biology.* Milk is not coagulated at first, but in twenty-six days a coagulum was obtained on boiling; only very slight nitrate reduction. Litmus is reddened at first, but in thirty-five days the red begins to disappear and is replaced by purple, still later by blue (ninety days). Growth on solid media is translucent with more or less of an ocherous tint, sometimes almost light orange (lactose-litmus gelatin). There is a slight surface growth on broth; rosolic acid is deepened in color. Surface colonies on gelatin are clear, rather irregular, slightly veined; the deep ones are round, dusky yellowish.

40. **Bacillus domesticus** n. sp.

*Occurrence.* In the air of an apartment house on West 69th street.

*Morphology.* Rather small rounded bacilli,  $.5 \times 1 \mu$ , mostly in pairs, not motile.

*Biology.* Nitrate is reduced rather slowly, but completely in seventeen days. A slight pink tint may be seen in the surface of milk. Litmus is made red but in fifty days begins to be replaced by blue. Growth on solid media at first white, but later shining light yellow, slowly spreading. Grows well on potato and glycerine agar. The surface colonies on gelatin are larger than the deep ones, thin, granular yellowish centrally with even edge.

*Remarks.* Seems near *B. striatus flavus* von Besser, but the cells are not curved and I did not notice any striations.

Also near No. 42, but the nitrate is much more strongly reduced.

41. **Bacillus fluorescens tenuis** (Zimmermann).

*Occurrence.* "Micrococcus versicolor" from the college collection.

*Morphology.* Rather short bacilli, mostly in short chains,  $.6 \times 1-2 \mu$  actively motile.

*Biology.* Nitrate quite strongly reduced but not completely. Growth on agar translucent white with a green fluorescence in the medium; lactose-litmus permanently reddened.

*Remarks.* See remarks under No. 35.

42. **Bacillus amabilis** n. sp.

*Occurrence.* In the air of the college hallway.

*Morphology.* Very short bacilli, often nearly spherical,  $.7 \times .8-1 \mu$  singly or in irregular chains or masses; not motile.

*Biology.* Nitrate slightly reduced. On agar a narrow translucent white streak with pale yellow tint; surface colonies rather large, translucent, yellowish, on potato a very thin growth, bright yellow with ill defined edges. Produces no indol; rosolic acid not changed.

*Remarks.* The cultures died during the summer vacation.

43. **Bacillus flavocoriaceus** (Eisenberg).

*Occurrence.* In the air of an apartment house on West 69th street.

*Morphology.* Rounded bacilli, singly or in masses  $.6 \times 1-1.5 \mu$ .

*Biology.* Nitrate quite well reduced but not completely. Growth on solid media rather dark yellow, shining, the edges inclined to be translucent. Scarcely any growth was obtained on potato. Rosolic acid a little deepened in color.

44. **Bacillus javaniensis** n. sp?

*Occurrence.* "Photobacterium javaniensis" from the college collection.

*Morphology.* Short elliptical bacilli, almost like cocci, about  $1-1.2 \mu$  in diameter, in masses, short chains, twos or fours, not motile.

*Biology.* Nitrate is strongly reduced but not completely; rosolic acid unchanged. Growth on agar thick, white, with a distinct yellow tinge; grows slowly.

*Remarks.* I have met with no description of this species and apply the name with which it was labelled.

45. **Bacillus decolorans minor** n. sp.

*Occurrence.* In the air of an apartment house on West 69th street.

*Morphology.* Rounded bacilli  $.6 \times .6-1.1 \mu$ , frequently in pairs, not motile.

*Biology.* Nitrate slowly reduced but completely in twenty-eight days; rosolic acid decolorized; indol formed in peptone-salt broth. In gelatin cultures, surface growth waxy white, not shining, irregular and finely lumpy, slight growth along puncture. Surface colonies large, spreading, translucent white with irregular edges; deep ones dusky yellowish, not characteristic. On agar translucent whitish, rather thin, shining. On potato very slight brownish translucent growth, not abundant.

46. **Bacillus secundus Fulles** n. sp.

*Occurrence.* In the air of the college yard near 59th street.

*Morphology.* Large bacilli, short, rounded, singly, often constricted,  $.7-1 \times 1-2 \mu$ ; not motile.

*Biology.* Nitrate quite well reduced but not completely; rosolic acid not faded. Growth on agar white, rather thin, lactose-litmus made blue.

*Remarks.* Seems to be not contradicted by the description of *Bacillus* No. II. of Fulles.

47. **Bacillus aquatilis sulcatus quartus** (Weichselbaum).

*Occurrence.* In a trap of *Utricularia vulgaris*, Plattsburgh, N. Y., in September.

*Morphology.* Rounded bacilli,  $.6 \times 1.5 \mu$ , in pairs or short chains; in older cultures growing out into long straight chains; the free cells actively motile.

*Biology.* Nitrate partly reduced; rosolic acid unchanged.

*Remarks.* I have applied the name *B. aquatilis sulcatus*, No. IV., of Weichselbaum, to this form, as it seems not to positively contradict the description.

48. **Bacillus primus Fullesi** n. sp.

*Occurrence.* In a leaf of *Sarracenia purpurea* at Plattsburgh, N. Y.

*Morphology.* Small rounded bacilli, singly and in pairs, do not form long chains;  $.5-.6 \times .8-1 \mu$ , actively motile, but becoming much less so in old cultures (twenty-five days).

*Biology.* Nitrate reduced, at length completely, rosolic acid not changed; the cultures in milk emit a disagreeable odor.

*Remarks.* The Bacillus No. I., of Fulles, seems to correspond.

49. **Bacillus diphtheriæ** (Klebs).

*Occurrence.* From the college collection.

*Morphology.* Short bacilli, nearly spherical, irregular;  $.8 \times 1 \mu$  (grown at room temperature).

*Biology.* Grows very poorly at room temperature so that the characters are not all reliable. Nitrate well reduced in twenty-eight days but not completely.

50. **Bacillus erythrosporous** (Eidam).

*Occurrence.* From the college collection.

*Morphology.* Rounded bacilli,  $.6 \times 1-1.5 \mu$ , singly or in short chains; motile, form spores.

*Biology.* A slight trace of reduction of nitrate; rosolic acid decolorized; lactose-litmus made blue at first, but in sixty days the color becomes purple, and in one hundred days bright red. Growth on agar translucent white, a green fluorescence in the medium.

51. **Bacillus fluorescens putidus** (Flügge).

*Occurrence.* (1) From the college collection. (2) From Král's laboratory at Prague. (3) In the exudation from the anus of some sick lepidopterous larvæ (*Clisiocampa fragilis*) bred in confinement.

*Morphology.* Rounded bacilli,  $.6-.8 \times 1-2 \mu$ , singly or in short chains, actively motile.

*Biology.* Nitrate not reduced, rosolic acid not changed; lactose-litmus blue at first but begins to redden in sixty to ninety days. The reddening became most pronounced in culture (3). Agar growth translucent white with a green fluorescence in the medium.

52. **Bacillus fluorescens aureus** (Zimmermann).

*Occurrence.* From the college collection.

*Morphology.* Large, rather slender bacilli,  $.7-1 \times 1-5 \mu$ , singly or in chains; spsmodically motile, the longer chains bending at the joints.

*Biology.* As above, but the growth is yellow. The description says ocherous or golden yellow, but the culture before me has become a very pale yellow. No sign of reddening of lactose-litmus in forty-five days.

53. **Bacillus fuscus** (Zimmermann).

*Occurrence.* (1) "*Bacillus chrysogloia*" from Krål's laboratory. (2) In the air of the college hallway. (3) A contamination from the air of the college laboratory.

*Morphology.* Rounded bacilli,  $.5-.7 \times 1-2 \mu$ , singly or in chains of various lengths; not motile.

*Biology.* Nitrate not reduced or but slightly. Growth characteristically wrinkled with lobed edges, of crusty brittle texture forming a surface skin on liquid media; color light orange. Rosolic acid not changed. Aerobic.

*Remarks.* Does not correspond to the description of *B. chrysogloia* Zopf.

54. **Bacillus fuscus pallidior** n. sp.

*Occurrence.* "*Bacillus latericeus*" from Krål's laboratory.

*Morphology.* Rounded bacilli  $.5-.7 \times 1-1.3 \mu$ , singly and in chains.

*Biology.* As in No. 53, but the growth is a very pale whitish orange, almost pinkish.

*Remarks.* Does not correspond to *B. latericeus* Eisenberg.

55. **Bacillus ferrugineus** n. sp.

*Occurrence.* (1) A contamination from the air of the college laboratory. (2) From a fresh leaf of *Sarracenia purpurea* at Plattsburgh, N. Y.

*Morphology.* Little rounded bacilli  $.6 \times 1 \mu$ , in pairs or chains of various lengths; not motile.

*Biology.* Much as in Nos. 53 and 54 but the growth is red, brick red instead of orange; it is crusty or granular, scarcely wrinkly as the preceding are; grows slowly. Nitrate not reduced, milk not changed, but an abundant brick-red growth forms on the surface. In broth a complete surface skin is not formed. The gelatin colonies under a low power appear like a round tuft of cotton but small and regular.

56. **Bacillus salmoneus** n. sp.

*Occurrence.* In the air of the college hallway.

*Morphology.* Small rounded bacilli,  $.5 \times .7 \mu$ , singly or in short chains, not motile.

*Biology.* A slight reduction of nitrate; growth on agar narrow, shining, salmon pink, quite opaque where thick. No surface growth on broth. Deep gelatin colonies rounded, regular, smooth, uncharacteristic.

57. **Bacillus finitimus ruber** n. sp.

*Occurrence.* (1) Four times in the air of the college hallway. (2) In the air on West 59th Street. (3) "*Micrococcus cinnabareus*" from the college collection.

*Morphology.* Short rounded bacilli  $.5 \times .6-1 \mu$ , singly or in chains of three or four, not motile.

*Biology.* Nitrate not reduced but in one instance considerably reduced. Resembles Nos. 56 and 58 but the color of the growth is reddish pink or rather bright red.

58. **Bacillus rhodochrous** ( Overbeck ).

*Occurrence.* ( 1 ) " *Micrococcus rhodochrous* " from Krål's laboratory. ( 2 )

In the air of the college hallway.

*Morphology* and biology as above, but the growth is a fine pink with the free access of air.

59. **Bacillus brunneoflavus** n. sp.

*Occurrence.* " *Micrococcus brunneus* " from Krål's laboratory.

*Morphology* and Biology. As in Nos. 57 and 58 but the growth is bright orange. There is a slight reduction of nitrate ; rosolic acid not changed.

*Remarks.* Does not correspond with *Bacillus brunneus* Adametz.

60. **Bacillus flavocoriaceus** ( Eisenberg ).

*Occurrence.* In the air of the college hallway.

*Morphology.* Very short bacilli, regular and uniform,  $.5 \times .7\mu$ , singly or in chains of two or three ; not motile.

*Biology.* Characters all negative. Grows well on glycerine agar, but not on potato or at  $37\frac{1}{2}^{\circ}$  C.

*Remarks.* The gelatin colonies are not coarsely granular, but smooth. In other respects, the description of Eisenberg is not contradictory.

61. **Bacillus zürnianum** ( List ).

*Occurrence.* In the air of the college hallway.

*Morphology.* Small rounded bacilli,  $.5 \times .6-1\mu$ , singly or in short chains, not motile.

*Biology.* A very slight reduction of nitrate. Cultures on solid media translucent white, very viscous, drawing out into long threads. Does not produce indol in peptone-salt solution.

*Remarks.* These bacilli are not as long as *B. zürnianum* List but seems to correspond otherwise.

62. **Bacillus decolorans major** n. sp.

*Occurrence.* ( 1 ) In the air of an apartment house on West 69th Street. ( 2 )

In the air of the college hallway.

*Morphology.* Very short rounded bacilli  $.7-.9 \times 1-2\mu$ , singly or in chains of various lengths, not motile.

*Biology.* As in No. 61, except that the growth is not in the least viscous, and indol is formed in the peptone-salt broth. The decolorization of rosolic acid does not take place at once but is complete in from sixteen to twenty-five days.

*Remarks.* Differs from No. 45 in that the cells are larger and that nitrate is not reduced or but partially so.

63. **Bacillus zopfii** ( Kurth ).

*Occurrence.* ( 1 ) " *Bacterium zopfii* " from the college collection. ( 2 ) " *Proteus zenkeri* " from the college collection. ( 3 ) " *Proteus mirabilis* "

from the college collection. (4) "*Bacillus ramosus non-liquefaciens*" from Král's laboratory. (5) "*Bacillus figurans*" from the college collection.

*Morphology.* Large straight rod-shaped bacilli  $.8 \times 1-4\mu$ , but soon breaking up into shorter cells in older cultures; singly or in chains; motile. In a twenty-one day culture the bacilli were very short, of the shape of spores but more spherical.

*Biology.* Nitrate not reduced or but slightly. The growth on gelatin, both colonies and streak is very characteristic, sending off fine ramifying branches far out into the medium. On agar the growth is thin, white, more or less feathery on the edges. Indol is formed. Lactose-litmus quickly made blue.

*Remarks.* *Proteus zenkeri* is probably the same species as *B. zopfi*. The other cultures before me seem to be wrongly named.

#### 64. *Bacillus lactis cyanogenus* (Hueppe).

*Occurrence.* (1) "*Bacillus* of blue milk" from the college collection. (2) "*Bacillus cuniculicida*" from Král's laboratory.

*Morphology.* Rounded, thick bacilli,  $.7-1 \times 1-1.5\mu$ , singly or in pairs, actively motile.

*Biology.* Nitrate not reduced or but slightly; aerobic, as shown by the growth in the fermentation tube. A slight surface growth on broth. Agar growth translucent white.

*Remarks.* The characteristic blackish color was produced in none of my media, although I made a culture in milk with an acid forming bacillus as recommended. The cells were twice as thick as described by Hueppe, but corresponded with the measurement of Jordan. I was unable to differentiate the culture sent to me as "*Bacillus cuniculicida*" from this species, as neither produced the black color, and they corresponded very closely otherwise. This culture does not correspond with the description of *B. cuniculicida* (*B. septicaemiae haemorrhagicae* according to Sternberg), as this is said to be not motile.

#### 65. *Bacillus typhi abdominalis* (Eberth).

*Occurrence.* (1) "*Bacillus typhosus*" from the college collection. (2) In the air of the college hallway. (3) From a fresh leaf of *Sarracenia purpurea* at Plattsburgh, N. Y.

*Morphology.* Slender rounded bacilli  $.5-.7 \times 1-2\mu$ , singly or in chains; motile. In No. 3 the cells measure about  $.5 \times .7\mu$  only.

*Biology.* Nitrate not reduced or partially so in fifty days. Growth on solid media translucent white.

*Remarks.* I do not wish to be understood to imply that the bacilli found by me in the air and the pitcher plant would produce typhoid fever, or even that they are pathogenic. The presumption is that they are not, and I have only included them here because they did not differentiate themselves on the media used. In this group, the characters are all negative, and we may have to do with closely allied species. I have tried to apply

the characters uniformly in all cases, and I think we may learn as much from cases where separations apparently fail to be made as where they come out unexpectedly.

66. **Bacillus candicans** (Frankland).

*Occurrence.* (1) Twice in the air of West 59th Street. (2) In the air of the college (Dr. Cheesman). (3) A contamination, from the air?

*Morphology.* Short rounded bacilli,  $.5-.8 \times .8-1.3\mu$ , singly or in twos or threes; not motile.

*Remarks.* Resembles No. 62, but rosolic is not decolorized.

67. **Bacillus Martinezii** (Sternberg).

*Occurrence.* A contamination from the air of the college laboratory.

*Morphology.* Rounded bacilli,  $.5 \times 1-1.5\mu$ , singly or in short straight chains; not motile.

*Biology.* Nitrate slightly reduced in twenty-eight days; rosolic acid deepened in color; growth on agar translucent white. Gelatin colonies are large, irregular streaked, almost reticulated, with irregular edge; the mass has a veriform appearance.

*Remarks.* As Sternberg's description does not seem to contradict this culture in any essential feature, I have applied his name to it, though I have no other reason for supposing them to be the same.

68. **Bacillus inutilis** n. sp.

*Occurrence.* Three colonies on some plates exposed to the air in West 59th Street, and grown at  $37\frac{1}{2}^{\circ}$  C.

*Morphology.* Short, rounded bacilli, rather large,  $1 \times 1-2\mu$ , singly and in pairs.

*Biology.* Characters all negative, growth forms uncharacteristic, on solid media very thin, translucent; grows both at room temperature and at  $37\frac{1}{2}^{\circ}$  C.

LIQUEFYING BACILLI.

(Synopsis of species.)

Nitrate not reduced or but very slightly.

Milk not coagulated.

Lactose-litmus not reddened.

Not chromogenic.

Large bacilli,  $.5\mu$  wide or more; form spores.

Growth skinny; a surface skin on broth (see 88 and 89).

Growth not skinny or crusty.

Growth viscous; not motile..... 69

Growth not viscous; motile.

Shining translucent white on agar.

No growth on potato..... 70

Growth on potato abundant, but nearly invisible.. 71

Very thin and transparent on agar

No growth on potato..... 72

An abundant growth on potato like brown varnish. 73

|  |    |
|--|----|
| Very small bacilli ; not motile.....                             | 74 |
| Chromogenic.   |    |
| A greenish fluorescence.....                                     | 75 |
| Color orange-yellow, growth skinny.....                          | 76 |
| Color orange or brownish, growth soft.....                       | 77 |
| Color yellow (see 104 to 107).                                   |    |
| Lactose-litmus reddened ; chromogenic ; not motile.              |    |
| Growth thin, translucent, reddish where thick.....               | 78 |
| Growth yellow, rather opaque.....                                | 79 |
| Milk coagulated ; always so on boiling.                          |    |
| Lactose-litmus reddend.  |    |
| A green fluorescence ; also a black pigment in presence of sugar | 80 |
| Not fluorescent ; more or less chromogenic.                      |    |
| Motile.....  | 81 |
| Not motile.  |    |
| Growth ocherous, faintly chromogenic.....                        | 82 |
| Growth translucent salmon-pink.....                              | 83 |
| Growth brownish red or dark orange-red.....                      | 84 |
| Lactose-litmus reddened.   |    |
| Chromogenic ; yellow.....  | 85 |
| Not chromogenic.   |    |
| No complete surface skin on broth.                               |    |
| Growth white, marked with more opaque white.....                 | 86 |
| Growth very thin and translucent.....                            | 87 |
| A wrinkly surface skin on broth.                                 |    |
| Spore-bearing cells wider than vegetative ones.....              | 88 |
| Cells alike, the spore-bearing ones distended by the spores.     | 89 |
| Nitrate reduced, at least partially in twenty-eight days.        |    |
| Milk coagulated, especially so on boiling.                       |    |
| Growth white, waxy, dotted or feathery.                          |    |
| Growth rather thin, granular, dotted or punctate.....            | 90 |
| Growth more opaque like ground glass, more or less feathery.     |    |
| Growth subcrystalline, finely angularly marked.....              | 91 |
| Growth scarcely more than finely granular, uniform.              |    |
| Not, or but slightly wrinkly.....                                | 92 |
| With transverse, convex folds or wrinkles.....                   | 93 |
| Growth rather opaque, feathery, with concave creases.....        | 94 |
| Growth very thin, spreading.....                                 | 95 |
| Chromogenic, sometimes only faintly so.                          |    |
| Color ocherous.  |    |
| Long, slender bacilli.....                                       | 96 |
| Very small, short bacilli (see 77).                              |    |
| Color pinkish red, rarely white.                                 |    |
| Growth viscous.....  | 97 |
| Growth not viscous.....  | 98 |



|  |     |
|--|-----|
| Color blackish violet.....   | 99  |
| Faintly chromogenic, creamy when old.                                      |     |
| Growth moderately opaque ; no fluorescence,                                |     |
| Growth smooth, shining.....  | 100 |
| Growth coarsely granular, the lobed parts nearly smooth...                 | 101 |
| Granular punctate with impressed wrinkles ; no lobes.....                  | 102 |
| Growth rather thin ; a green fluorescence .....                            | 103 |
| Milk not coagulated ; if apparently so, no firm coagulum on boiling.       |     |
| Yellow ; milk often distinctly coagulated in the cold, but not on boiling. |     |
| Lactose-litmus made blue.  |     |
| Growth, soft, smooth, shining.   |     |
| Gelatin quickly liquefied.....   | 104 |
| Gelatin slowly liquefied.....  | 105 |
| Growth lumpy, granular .....   | 106 |
| Growth heavily creased (convex).....                                       | 107 |
| Lactose-litmus reddened ; growth viscous .....                             | 108 |
| A green fluorescence in the medium .....                                   | 109 |
| Bright orange ; growth forming a crusty skin.....                          | 110 |
| Faintly chromogenic or not.  |     |
| Rosolic acid unchanged or darkened.....                                    | 111 |
| Rosolic acid decolorized ... ..  | 112 |

#### 69. **Bacillus vermiculosus** (Zimmermann.)

*Occurrence.* From Král's laboratory.

*Morphology.* Square ended bacilli,  $1 \times 2-4 \mu$ , singly or in chains, not motile.

*Biology.* Gelatin slowly liquefied, not complete in twenty-eight days ; usually begun in fourteen days. The growth on agar is viscous, coming off in long strings on the needle. Rosolic acid not changed. On potato the growth is broad and thick of a sordid flesh color.

#### 70. **Bacillus alpha** n. sp.

*Occurrence.* In the air on West 59th Street.

*Morphology.* Large bacilli,  $.8 \times 1-2 \mu$ , singly or in long close straight chains ; motile.

*Biology.* Gelatin not liquefied at first, but well liquefied in one-hundred days. Some colonies on a gelatin plate liquefied in eleven days. Rosolic acid not changed ; produces some indol.

#### 71. **Bacillus beta** n. sp.

*Occurrence.* In the air of the college hallway.

*Morphology.* Short, large bacilli with rounded ends,  $.6 \times 1.5-2 \mu$ , actively motile, forms spores.

*Biology.* Gelatin liquefied rather slowly, the surface growth on this medium very feathery and thin without definite boundary. Rosolic acid not changed ; forms some indol.

**72. *Bacillus circulans* (Jordan).**

*Occurrence.* In the air of the college hallway.

*Morphology.* Large bacilli with rounded ends,  $.6 \times 1-2\mu$ , mostly singly; motile.

*Biology.* Gelatin rather slowly liquefied; milk not coagulated; nitrate very slightly reduced in twenty-eight days; rosolic acid not decolorized; forms a little indol. Growth on agar thin and translucent.

**73. *Bacillus Scheurleni* (Sternberg).**

*Occurrence.* In the air on West 59th Street.

*Morphology.* Large rounded bacilli,  $.7-1 \times 1-2.5\mu$ , singly and in short chains motile; forms spores.

*Biology.* Gelatin quickly liquefied; rosolic acid not changed, forms no indol, nitrate very slightly reduced in twenty-eight days.

*Remarks.* Apparently corresponds to the "*Bacillus* of Scheurlen" described in Sternberg's manual.

**74. *Bacillus incanus* (Pohl).**

*Occurrence.* In a leaf of *Sarracenia purpurea* at Plattsburgh, N. Y.

*Morphology.* Small rounded bacilli,  $.4-.5 \times .6-1\mu$ , usually in short chains, not motile, does not form spores (115 days on agar).

*Biology.* Gelatin liquefied rather slowly, nitrate slightly reduced, rosolic acid not changed; growth on agar translucent white, not broad, irregularly streaked.

*Remarks.* I have identified this with *B. incanus*, though with some hesitation, as that species is said to be slightly motile, and the growth on agar is described as granular.

**75. *Bacillus fluorescens nivalis* (Schmolek).**

*Occurrence.* In the exudate from a sick lepidopterous larva (*Scoliopteryx libatrix*) at Keene Valley, N. Y.

*Morphology.* Rather slender bacilli,  $.5-.7 \times 1-3\mu$ , mostly singly, actively motile.

*Biology.* Gelatin quickly liquefied; rosolic acid nearly decolorized in sixteen days; nitrate not reduced; growth on agar thin and translucent, a fine greenish fluorescence in the medium.

*Remarks.* Differs from No. 109 in not reducing nitrate. I have identified this as above rather than describe it as new, though there is nothing in the description to differentiate it from No. 109.

**76. *Bacillus gamma* n. sp.**

*Occurrence.* In the air of the college yard, near West 59th Street.

*Morphology.* Bacilli associated in thick adherent masses,  $.5-.7 \times 1-1.5\mu$ , motile, in old cultures many small spherical forms are seen.

*Biology.* Milk not coagulated, but the casein ultimately dissolved; lactose-litmus is made blue, though sometimes this is obscured by the decoloring effect; nitrate not reduced, rosolic acid not changed. The species is

aerobic and forms a thick compact surface skin on liquid media. On agar the growth is broad, translucent ochereous yellow, concentrically marked. It comes off in pieces under the needle and is difficult to transfer.

#### 77. *Bacillus rubidus* (Eisenberg).

*Occurrence.* (1) As a contamination. (2) Three times in the air of the college yard near 59th street. (3) In a trap of the carnivorous water plant *Utricularia vulgaris* in Dead Creek, Plattsburgh, N. Y.

*Morphology.* Small rounded bacilli  $.5-.7 \times .6-1 \mu$ , singly or in short chains, not motile except No. (3) which was motile when fresh but not in older cultures.

*Biology.* Gelatin quickly liquefied, but in No. (1) not for seventy days and then only a dry hollow was found. Milk not coagulated usually, but in a culture of No. (3) there was coagulation or boiling in fourteen days, but not subsequently. In another of No. (3) there was a partial pastry coagulum in twenty-eight days on boiling. Nitrate not reduced or very slightly. The growth on agar varies in color, but is of a translucent reddish brown shading into yellowish, orange or whitish.

*Remarks.* These cultures are not all alike, as will be noticed, and do not correspond entirely with Eisenberg's description, but I have preferred to regard them as varieties of one species.

#### 78. *Bacillus delta* n. sp.

*Occurrence.* From a water plate.

*Morphology.* Short bacilli,  $.5 \times .8-1 \mu$ , singly and in short chains, not motile.

*Biology.* Gelatin slowly liquefied, beginning in twenty-one days. Milk not coagulated on boiling, though it may appear somewhat so before. Rosolic acid not changed. On agar the growth is so thin that its red color is scarcely apparent, but it is evident on milk at the surface. Grows well at  $37\frac{1}{2}^{\circ}\text{C}$ , of a translucent light pink. On potato shining, light red, not greatly spreading.

#### 79. *Bacillus fulvus* (Zimmermann).

*Occurrence.* (1) In the air of the college hallway. (2) In the air of an apartment house on West 69th street. (3) From a water plate.

*Morphology and biology.* Under the above name, I associate three cultures which agree in liquefying gelatin very slowly, usually not for twenty-one days. Lactose-litmus reddened, rosolic acid not changed, no surface growth on broth. They differ as follows: (1)  $.5 \times .7-1 \mu$ ; indol formed abundantly; on potato a narrow rather shining bright yellow growth; lactose-litmus permanently reddened. (2)  $1 \times 1.2 \mu$ ; scarcely any indol formed; no growth on potato; lactose-litmus permanently reddened. (3)  $.4 \times .5 \mu$ ; considerable indol is formed; on potato a coarse densely granular dry growth, brown centrally, yellow on the edges; lactose-litmus made red, but later becomes blue.

*Remarks.* I am unable to decide whether these are distinct species or varieties

80. **Bacillus violaceus sacchari** (Ager).\*

*Occurrence.* In the air of the college yard.

*Morphology.* Short bacilli  $.5 \times .7-1 \mu$ , singly or in short chains, actively motile.

*Biology.* Gelatin quickly liquefied, milk coagulated, rosolic acid faded. Produces a green fluorescence and also a blackish color in the presence of glucose, lactose, glycerine and in some samples of broth, also on the addition of formaline.

*Remarks.* Differs from No. 75 in producing the violaceous black pigment. This is very well marked in old cultures in milk.

81. **Bacillus Hudsonii** n. sp.

*Occurrence.* (1) In the air of the college hallway. (2) A contamination from the air of the laboratory. (3) Twice in the air of the college yard. (4) A culture obtained by Prof. G. H. Hudson at Plattsburgh, N. Y.

*Morphology.* Small rounded bacilli,  $.5-.6 \times .7-1.5 \mu$ , singly or in pairs; motile.

*Biology.* Gelatin quickly liquefied, milk coagulated after 14 days, finally forming a distinct curd which is sometimes dissolved. Nitrate not reduced or very slightly; rosolic acid not changed. On potato the growth is thin, translucent ochereous or orange tinted. The amount of reddening of lactose-litmus varied somewhat in the different cultures. On glycerine agar an abundant growth is formed, thick, but translucent or of a mustard color, while a considerable accumulation of orange pigment collects in the condensation water in the bottom.

82. **Bacillus oxylacticus** n. sp.?

*Occurrence.* (1) "Bacillus oxylacticus" from Krål's laboratory. (2.) In the air of the college yard.

*Morphology.* Rather large bacilli  $1-1.3 \times 1.7-2.5 \mu$ , singly or in long chains; not motile.

*Biology.* Gelatin quickly liquefied, nitrate not reduced, rosolic acid not changed; on potato the growth is shining watery translucent, somewhat marked with more opaque white. Growth on agar white with a faint ochereous yellow tint.

*Remarks.* I have seen no description of "Bacillus oxylacticus."

83. **Bacillus epsilon** n. sp.

*Occurrence.* In the air of the college yard.

*Morphology.* Small rounded bacilli  $.5 \times .7-1 \mu$ , not motile.

*Biology.* Gelatin rather quickly liquefied, nitrate not reduced, rosolic acid not faded; growth on agar translucent pink, shining.

84. **Bacillus zeta** n. sp.

*Occurrence.* In the air of the college hallway.

*Morphology and biology.* As in No. 83 but the growth is shining orange color. Growth is slow and liquefaction does not begin before ten days; on the surface of milk a layer of red cream forms.

\*New York Medical Journal, 1894, p. 265.

85. **Bacillus Fischeri** (Beyerinck.)

*Occurrence.* ( 1 ) "Photobacterium phosphorescens" from Krål's laboratory. ( 2 ) "Photobacterium balticum" from Krål's laboratory. ( 3. ) "Photobacterium fischeri" from Krål's laboratory. ( 4 ) "Photobacterium Pflügeri" from Krål's laboratory.

*Morphology.* Short bacilli  $.5-.6 \times .6-1.2 \mu$ , usually singly.

*Biology.* Gelatin liquefied slowly, usually in twenty-eight days. Milk coagulated but very slowly and often not demonstrable in twenty-eight days ; in No. ( 4 ) in one hundred and seventy days ; nitrate slightly reduced but very slowly. Growth on solid media is yellow, but it takes place slowly and the cultures are liable to die. Rosolic acid and lacose-litmus are unchanged.

*Remarks.* Apparently differs from *B. argenteo phosphorescens liquefaciens* Katz only in liquefying geletin much more slowly.

86. **Bacillus proteus vulgaris** ( Hauser. )

*Occurrence.* "Proteus vulgaris" from the college collection.

*Morphology.* Large rounded bacilli,  $.8 \times 1-2 \mu$ , singly and in long chains, the elements separated by spaces ; spasmodically motile.

*Biology.* In lactose-litmus gelatin little wandering colonies may be seen in the unliquefied part of the medium ; growth on agar soft, white ; scarcely a well defined surface growth on broth. Gelatin, quickly liquefied, milk coagulated, nitrate not reduced.

87. **Bacillus alvei** ( Cheshire & Cheyne. )

*Occurrence.* From the college collection.

*Morphology.* Slender straight bacilli  $.7 \times 3.5 \mu$ , in short chains, motile, forms spores.

*Biology.* Gelatin quickly liquefied, milk coagulated, nitrate slightly reduced. Growth on agar very thin, spreading. Rosolic acid not changed.

88. **Bacillus megaterium** ( De Bary. )

*Occurrence.* From the college collection.

*Morphology.* Slender bacilli,  $.8 \times 2-5 \mu$ , when about to produce spores the cells are more rounded and about  $1-1.2 \times 4 \mu$ , singly and in chains, not motile.

*Biology.* Milk was not coagulated in the first sample, but quickly in second one, nitrate not reduced. A wrinkled surface skin on broth.

89. **Bacillus subtilis** (Ehrenberg).

*Occurrence.* From the college collection.

*Morphology.* Large square ended bacilli,  $.7 \times 2-3 \mu$ , singly or in long chains ; spasmodically motile, from spores which are wider than the rods.

*Biology.* As in No. 88, but the growth has a more crusty texture. The same contradictory effect was produced in milk as in No. 88, but this may be due to differences in the samples of milk which were the same for these two species.

90. **Bacillus anthracis** (Pollender).

*Occurrence.* From the college collection.

*Morphology.* Large square ended bacilli,  $.8-1 \times 2-5 \mu$ , singly or in chains, the elements often separated by spaces; not (or spasmodically?) motile; forms large spores.

*Biology.* Gelatin quickly liquefied, milk rapidly coagulated, the coagulum slowly dissolved, nitrate completely reduced in two days; rosolic acid not changed; lactose-litmus not reddened.

91. **Bacillus crystalloides** n. sp.

*Occurrence.* A contamination on some plates of *B. lactis erythrogenes*.

*Morphology and biology.* As in No. 90, but the growth on agar is at first rather clear, refracting, checkered-crystalline; the edges with shallow lobes.\* Later it becomes thicker and opaque, coarsely granular, a little wrinkly, but on the thinner edges the crystalline markings persist.

92. **Bacillus ramosus** (Frankland).

*Occurrence.* (1) From Krål's laboratory. (2) "*Bacillus anthracoides*" from Krål's laboratory. (3) In the air on West 59th Street near the college. (4) With No. 91.

*Morphology and biology.* As in Nos. 90-91, but the growth on agar is smooth, finely granular and somewhat translucent, well defined and granular at the margin or a little feathery, scarcely at all creased.

93. **Bacillus lactis albus** (Löffler).

*Occurrence.* (1) Found by Dr. Kitchell in a mouse dead of anthrax. (2) In the air of the college hallway. (3) With No. 91.

*Morphology and biology.* As in Nos. 90-92. The cells are not motile or spasmodically so. In the media a yellow color may be produced of greater or less intensity, but the growth is not colored. The agar growth is as in No. 92, but usually wrinkled, forming elevated, sharp folds.

*Remarks.* Löffler has described some species of the anthrax group, and I apply his name to this form. The slower rate of liquefaction which he mentioned may be due to a difference in the composition of the media.

94. **Bacillus mycoides** (Flügge).

*Occurrence.* From the college collection.

*Morphology and biology.* As in Nos. 90-93, but the growth on agar is extraordinarily feathery and marked with concave creases.

*Remarks.* Nos. 90-94 may be but races of one species.

95. **Bacillus mesentericus vulgatus** (Flügge).

*Occurrence.* (1) From the college collection. (2) From the air in the college hallway. (3) A contamination in a culture of *B. helvolicus*.

*Morphology.* Large, rather square-ended bacilli,  $.7-1 \times 1-3 \mu$ , singly or in long chains, not or spasmodically motile, form spores.

\*Dr. Cheesman has obtained this identical growth from cultures of *Bacillus anthracis*.

*Biology.* Gelatin quickly liquefied, milk coagulated, but usually not till after some time; nitrate partly reduced, not completely; lactose-litmus not reddened. Growth on agar translucent white with a marked tendency to spread over the surface in a very thin layer.

96. **Bacillus ochraceus** (Zimmermann).

*Occurrence.* From Krål's laboratory.

*Morphology.* Slender bacilli,  $.4 \times 1-3 \mu$ , singly or in chains separated by spaces; not motile.

*Biology.* As in No. 95, but the growth is very different, being opaque, orange yellow streaked with white, not spreading widely.

*Remarks.* This species is said to be motile, "slow and serpentine," but my cultures did not show it.

97. **Bacillus prodigiosus** (Ehrenberg).

*Occurrence.* From the college collection.

*Morphology.* Small rounded bacilli,  $.5 \times 1 \mu$ , mostly singly, actively motile.

*Biology.* Gelatin quickly liquefied, nitrate completely reduced; lactose-litmus reddened. The cultures on agar were viscid.

*Remarks.* This species is said to form gas in presence of sugar, but my cultures did not, and it seems more likely that this species and *B. rosaceus metalloides* (No. 113) have been confounded, as they are closely alike except for the gas formation.

98. **Bacillus indicus** (Koch).

*Occurrence.* "Bacillus indicus ruber," from the college collection.

*Morphology and biology.* As in No. 97 except that the growth is not viscid. (Compare Nos. 113 and 114.)

*Remarks.* The culture before me has become white. This form is not to be distinguished from the white variety of No. 97. I do not know whether its chromogenic form is the same or not.

99. **Bacillus violaceus laurentius** (Jordan).

*Occurrence.* (1) "Bacillus violaceus," from Krål's laboratory. (2) "Micrococcus violaceus," from Krål's laboratory.

*Morphology.* Small bacilli,  $.5 \times 1 \mu$ , singly or in long chains, motile.

*Biology.* Gelatin quickly liquefied, milk coagulated, nitrate completely reduced and rapidly; lactose-litmus made blue, rosolic acid not changed; forms indol; scarcely any growth on potato.

*Remarks.* This can not be *B. violaceus* Frankland, as it was not observed to form spores. It differs from *B. lividus* Plagge and Proskaner in liquefying gelatin rapidly. It differs from *B. jacinthus* Zopf, in coagulating milk, while the growth is not tough, but agrees with it in reducing nitrate quickly. It differs from *B. violaceus laurentius* Jordan in reducing nitrate quickly, in producing the violet color in ordinary broth and in not growing on potato; but I have not felt justified to consider these differences as specific.

**100. *Bacillus mesentericus fuscus* (Flügge).**

*Occurrence.* (1) From the college collection. (2) "*Bacillus disciformans*," from Král's laboratory. (3) A contamination in a milk culture of No. 10.

*Morphology.* Rather square-ended bacilli,  $.5 \times .9-4 \mu$ , singly or in chains, motile, form spores.

*Biology.* Gelatin quickly liquefied, nitrate only partially reduced, often only very slightly; lactose-litmus not reddened, rosolic acid not changed. Growth on agar soft, when moderately old pale creamy or ochereous in tint, inclined to be lobed on the edges. Forms a crusty partial skin on broth.

**101. *Bacillus m. fuscus granulatus* n. sp.**

*Occurrence.* Abundantly in a jar of "sterilized milk" with No. 1.

*Morphology and biology.* As in No. 100, but the growth on agar is rather coarsely granulated, and nitrate is completely reduced in twenty-eight days.

**102. *Bacillus m. fuscus consistens* n. sp.**

*Occurrence.* A contamination in a milk culture of No. 10 with No. 100.

*Morphology and biology.* As in No. 100, but little wandering colonies were seen in lactose-litmus gelatin in the unliquefied part of the medium as in *B. proteus vulgaris*, the bacilli in the chains were separated by well-marked spaces and the growth on agar was creased and irregular, the edges turning down, almost cutting into the surface of the medium, and was very coherent and difficult to plant. For the hanging drop, it was necessary to break up the growth with two needles.

*Remarks.* Nos. 101 and 102 may be varieties of No. 100.

**103. *Bacillus pyocyaneus* (Gessard).**

*Occurrence.* "*B. pyocyaneus*" from the college collection.

*Morphology.* Small rounded bacilli  $.5 \times .7-1 \mu$ , singly or in short chains; motile.

*Biology.* Gelatin quickly liquefied, nitrate completely reduced, rosolic acid rather deepened in color, lactose-litmus made blue.

**104. *Bacillus lactis erythrogenes* (Hueppe).**

*Occurrence.* (1) From the college collection. (2) "*Bacillus versicolor*" from the college collection.\* (3) Thirteen times in the air of the college hallway and the yard.

*Morphology.* Very short bacilli,  $.6-.9 \times .9-1 \mu$ , singly in twos or short chains; not motile.

*Biology.* Gelatin quickly liquefied, milk apparently coagulated but without forming a curd on boiling, nitrate reduced completely, or more rarely

\* Dr. Prudden's description of *B. versicolor* seems rather to apply to No. 105 and his name has precedence over Zimmermann's. Probably both forms were before him and the more quickly liquefying one got preserved as the typical culture.



only partially; lactose-litmus made blue, rosolic acid not changed. Growth on solid media soft, thick, yellow, with a pink tint in the medium.

105. **Bacillus helvolus** (Zimmermann).

*Occurrence.* (1) From Krål's laboratory. (2) "Staphylococcus cereus flavus" from the college collection. (3) A contamination from the air of the college laboratory. (4) From the air of an apartment house on West 69th Street. (5) From air of the college hallway.

*Morphology.* As in No. 104, or the cells a little longer.

*Biology.* Gelatin slowly liquefied, sometimes not for thirty or forty days, but the character is variable; milk not coagulated; nitrate not reduced, slightly reduced, or even completely reduced, but usually not for some time. Growth on agar yellow with or without a pink tint in the medium.

*Remarks.* This form grades into the preceding. Zimmermann does not mention the pink pigment and it was not visible in my cultures from Europe at first, but came out some three months afterwards. My measurements are all shorter than those given in the books as the preparations were all made from agar cultures.

106. **Bacillus helvolus granulatus** n. sp.

*Occurrence.* Found in the process of purifying a culture of No. 105.

*Morphology and biology.* As in No. 105, but the growth on agar is granular lumpy, pale yellow, with scarcely any pink tint.

107. **Bacillus erythrogenes rugatus** n. sp.

*Occurrence.* This is the "wrinkly form" of No. 104 with which the experiments on discontinuous variations hereinbefore recounted were carried on.

*Morphology and biology.* It differs from No. 104 in that growth on agar is thin, skinny and covered with coarse wrinkles. (See figure.)

*Remarks.* This comes near *B. plicatus* Zimmermann, but liquefies gelatin much more rapidly, besides producing the pink color in media.

108. **Bacillus eta** n. sp.

*Occurrence.* In the air of the college hallway.

*Morphology.* Small rounded bacilli,  $.5 \times .7-1 \mu$ , mostly singly; not motile.

*Biology.* Gelatin liquefied slowly (in twenty-eight to one hundred days), milk not coagulated, nitrate completely reduced, but slowly; rosolic acid not changed. On solid media, yellow, viscous, with no pink tint.

109. **Bacillus fluorescens liquefaciens** (Flügge).

*Occurrence.* (1) From Krål's laboratory. (2) "Bacillus pyocyaneus" from the college collection.

*Morphology.* Short rounded bacilli,  $.5 \times .7-1.2 \mu$ , mostly singly, actively motile.

*Biology.* Gelatin quickly liquefied, milk not coagulated, but the casein is dissolved; nitrate well reduced but not completely. Lactose-litmus not reddened; rosolic acid decolorized.

110. **Bacillus fuscus liquefaciens** n. sp.

*Occurrence.* (1) "Bacillus fuscus" from Krål's laboratory. (2) A contamination from the air of the college laboratory.

*Morphology.* Slender bacilli.  $.5-.6 \times 1-2 \mu$ , singly or in short chains; not motile.

*Biology.* Gelatin liquefied slowly (in fourteen to fifty days), milk not coagulated, nitrate partly reduced. Lactose-litmus made blue, rosolic acid not changed.

*Remarks.* Differs from No. 53 only in that gelatin is ultimately liquefied. This comes near the description of *B. tremelloides* Schottelius, but the growth is never shining and the liquefaction is much slower.

111. **Bacillus theta** n. sp.

*Occurrence.* In the air of the college hallway.

*Morphology.* Rounded bacilli,  $.5-.7 \times 1-1.3 \mu$ , mostly in pairs; motile(?)

*Biology.* Gelatin slowly liquefied (twenty-one days), milk not coagulated; nitrate completely reduced in twenty-one days; lactose-litmus made blue. Growth on agar translucent ocherous, obscure. On broth, a surface skin gradually forms which may be made to sink entire. On potato, abundant shining brownish ocherous, thick and spreading.

*Remarks.* This seems related to No. 76, but nitrate is reduced and the growth is not just the same.

112. **Bacillus kappa** n. sp.

*Occurrence.* From a sick larva of *Scoliopteryx libatrix* with No. 75.

*Morphology.* Little rounded bacilli, singly and in pairs,  $.7 \times 1 \mu$ , not positively motile.

*Biology.* Gelatin liquefied in twenty-eight days; nitrate completely reduced. Lactose-litmus made blue. Growth white, soft, moderately opaque, not chromogenic. Forms a surface skin in the open arm of the fermentation tube.

GAS-FORMING BACILLI.

Synopsis of species.

|   |     |
|---|-----|
| Gelatin ultimately liquefied.                                     |     |
| Rosolic acid faded.   |     |
| Growth not viscous . . . . .                                      | 113 |
| Growth viscous . . . . .  | 114 |
| Rosolic acid not changed.   |     |
| Lactose-litmus reddened, but ultimately becomes blue.             |     |
| Agar growth opaque white.   |     |
| Not motile . . . . .  | 115 |
| Motile . . . . .  | 116 |
| Agar growth translucent, white, thin, sometimes lobed, spreading. |     |
| Colonies distorted, Proteus-like . . . . .                        | 117 |
| Colonies even, normal.  |     |
| Not or spasmodically motile . . . . .                             | 118 |
| Actively motile . . . . .   | 119 |

|   |     |
|---|-----|
| Lactose-litmus made blue at first ..... | 120 |
| Gelatin not liquefied.                  |     |
| Lactose-litmus permanently reddened.    |     |
| Growth fluid; cells in capsule .....    | 121 |
| Growth not fluid.                       |     |
| Nitrate partly reduced .....            | 122 |
| Nitrate completely reduced .....        | 123 |
| Lactose-litmus reddened, later blue.    |     |
| Rosolic acid not changed.               |     |
| Culture not viscous .....               | 124 |
| Growth very viscous .....               | 125 |
| Rosolic acid faded .....                | 126 |

### 113. *Bacillus rosaceus metalloides* (Dowdeswell).

*Occurrence.* (1) "*Bacillus miniaceus*" from Krål's laboratory. (2) "Red water from Brooklyn," from the college collection. (3) "*Bacillus magenta*," from the college collection. (4) "*Bacillus ruber* of Kiel" from Krål's laboratory.

*Morphology.* Small rounded bacilli,  $.5-.7 \times .8-1.3 \mu$ , singly, in pairs or short chains, motile, or partially so, often not motile. In old cultures, small spherical cells occur, gradually to the exclusion of the bacillar forms.

*Biology.* Gelatin liquefied, but not quickly; in fourteen days it is usually distinct, but may not ensue for thirty days. Milk is coagulated more or less rapidly, in all cases by twenty-one days, on boiling. Nitrate strongly reduced, usually completely. Lactose-litmus reddened. Gas is formed in the fermentation tube, and in cultures on lactose-litmus gelatin. A surface crust on broth. Rosolic acid decolorized. Growth on all media strongly chromogenic, fine crimson red, but a white form readily occurs on repeated cultivation.

### 114. *Bacillus Plymouthensis*.

*Occurrence.* "*B. rubrum*, Plymouth," from the college collection.

*Morphology and biology.* As above, except that the growth is viscous.

*Remarks.* This form is scarcely deserving of specific rank.

### 115. *Bacillus oxytocus perniciosus* (Flügge).

*Occurrence.* "*Oxytocus perniciosus*," from the college collection.

*Morphology.* Short, thick, rounded bacilli,  $1 \times 1.2-2 \mu$ , singly or in pairs; not motile.

*Biology.* Gelatin liquefied, but not before thirty-five days; milk coagulated; nitrate well reduced; lactose-litmus reddened.

*Remarks.* Described as not liquefying gelatin, but the liquefaction occurs so late that it may have been overlooked.

### 116. *Bacillus Kralii* n. sp.

*Occurrence.* "*Bacillus butyricus*" from Krål's laboratory.

*Morphology.* Short rounded Bacilli,  $.7 \times .8 \mu$ , mostly singly, motile, but not actively so.

*Biology.* Gelatin liquefied in about thirty days ; milk coagulated, nitrate well reduced but not completely.

*Remarks.* This cannot be *B. butyrius* Pragmowski which is anaërobic. It differs from *B. butyricus* of Hueppe in the size of the cells, the rate of liquefaction of gelatin and in other details. It apparently differs from *B. gasoformans* Eisenberg in liquefying gelatin much more slowly.

117. **Bacillus larvicida** n. sp.

*Occurrence.* In the exudate from the anus of a sick larva of *Clisiocampa fragilis*.

*Morphology.* Short rounded bacilli  $.8 \times 1 \mu$ , singly, and actively motile.

*Biology.* Gelatin liquefied in fourteen to twenty-one days ; milk coagulated ; nitrate completely reduced. Colonies on gelatin present curious twisted shapes like those described for the species of "Proteus."

118. **Bacillus lactis aërogenes** (Escherich).

*Occurrence.* From the college collection.

*Morphology.* Small rounded bacilli,  $.6 \times 1 \mu$ , singly or in pairs ; occasionally motile.

*Biology.* Gelatin liquefied in fifty days or not ; milk coagulated, nitrate partly reduced. One culture upon lactose-litmus gelatin produced liquefaction in fifty days and the reddening that first took place was succeeded by blue ; a second culture produced only reddening and no liquefaction.

*Remarks.* The second culture on lactose-litmus was not to be distinguished from *B. coli communis*. *B. lactis aerogenes* is said not to liquefy gelatin and be not motile, but these characters were not very markedly contradicted by the present culture, so I have preferred not to change the name.

119. **Bacillus vernicosus** (Zimmermann).

*Occurrence.* (1) From Krål's laboratory. (2) In the air of the college hallway.

*Morphology.* Small bacilli,  $.5 \times .6-1 \mu$ , singly and in short chains, actively motile.

*Biology.* Gelatin slowly liquefied, in from ten to thirty days, milk coagulated, nitrate not reduced or but very slightly.

*Remarks.* The cultures obtained by me from the air does not correspond exactly with the culture of *B. vernicosus* ; the growth has an ocherous tinge and seems otherwise slightly different. I cannot positively differentiate it, however.

120. **Bacillus pyogenes foetidus liquefaciens** n. sp.?

*Occurrence.* From Krål's laboratory.

*Morphology.* Small bacilli,  $.6 \times 1 \mu$ , singly or in pairs ; not motile.

*Biology.* Gelatin quickly liquefied, milk coagulated, nitrate not reduced. Colonies regular, uncharacteristic. Rosolic acid not decolorized.

*Remarks.* I have seen no description of this species.

121. **Bacillus Pruddeni** n. sp.

*Occurrence.* Found by Dr. Prudden in a case of Cystitis, the cells surrounded by a capsule.

*Morphology.* Rather large short bacilli,  $.9-1 \times 1.2 \mu$ , usually singly; not motile.

*Biology.* As in *B. coli communis*, with the exception that the growth has a soft consistency, so that an oblique culture on lactose-litmus gelatin it flows down to the base of the tube, but produces no liquefaction.

*Remarks.* This may be one of the many varieties of the following species, but I have not found a good description which covered the differential character which I have observed. The capsules did not appear so as to be noticed in preparations from an agar culture. Apparently this species is much like the "Pneumococcus" of Friedlander.

122. **Bacillus coli communis** (Escherich).

*Occurrence.* (1) From the college collection. (2) "*Bacillus neapolitanus*" from Krål's laboratory. (3) "*Bacillus cavioides*" from Krål's laboratory. (4) "*Bacillus der Fretchenseuche*" from Krål's laboratory. (5) "*Bacillus acidi lactici*" from the college collection. (6) "*Proteus hominis*" from the college collection.

*Morphology.* Short bacilli; some constricted,  $.6 \times .8-1.2 \mu$ , usually singly, not motile.

*Biology.* Milk coagulated, nitrate only partially reduced in twenty-eight days; rosolic acid not changed; growth not viscid.

123. **Bacillus Bookeri.**

*Occurrence.* Found by Dr. Prudden in a case of Cystitis.

*Morphology.* Very short bacilli, resembling cocci,  $.8 \times 1 \mu$ , partially motile.

*Biology.* Differs from the preceding in reducing nitrate completely.

*Remarks.* This may be the *Bacillus* f. of Booker which seems to be an unusually vigorous variety of *B. coli communis*.

124. **Bacillus acidiformans** (Sternberg).

*Occurrence.* From the college collection.

*Morphology.* Very short bacilli, resembling cocci,  $.6 \times .8-1 \mu$ , not motile.

*Biology.* Milk coagulated, nitrate partially reduced, rosolic acid not changed. Lactose-litmus is at first reddened, but in twenty-five days a blue spot appears which gradually spreads throughout the medium (ninety days).

125. **Bacillus capsulatus** (Pfeffer).

*Occurrence.* (1) From the college collection. (2) "*Bacillus synxanthus*" from Krål's laboratory.

*Morphology.* Bacilli varying considerably in size,  $.5-1 \times .7-1.5 \mu$ , singly or in short chains; not motile; no capsule seen.

*Biology.* Milk coagulated, nitrate completely reduced. The growth on agar is very viscid.

*Remarks.* Apparently *B. synxanthus* Schröter is the same as *B. capsulatus* Pfeffer. At any rate, I have been unable to differentiate these two cultures. Neither showed the capsule from agar cultures.

126. **Bacillus sordidus** n. sp. ?

*Occurrence.* "Micrococcus sordidus" from Král's laboratory.

*Morphology.* Short bacilli,  $.6-1 \times 1-1.5 \mu$ , singly or in pairs, rarely a short chain; not motile. In one preparation the bacilli were seen to be surrounded by a transparent capsule.

*Biology.* Milk coagulated, nitrate partly reduced, rosolic acid decolorized. The agar growth is very viscous and that on lactose-litmus gelatin forms a great jelly-like mass which may collect to a large extent in the bottom of the tube.

*Remarks.* I have seen no description of this species.

COMPOSITION OF THE MEDIA.

The following formulæ will explain the composition of the media used in the preceding investigations. All media were rendered alkaline to litmus to such a degree that they were still acid to phenol-ptalein, requiring from .1 to .2 cc. of tenth normal sodium hydrate\* for every cubic centimeter of the medium to render it neutral to the latter indicator. But if the medium, as first prepared, turned out more alkaline than this, no acid was added to it. The ordinary method of titration was used.

BROTH.

Extract of meat (Liebig's), . . . . .5 gr.  
Salt (NaCl), . . . . .5 gr.  
Pepton, . . . . .10 gr.  
Water (filtered), . . . . .1000 cc.  
Two eggs (to clear).

GELATIN.

Broth as above prepared, with the addition of 10 per cent. gelatin.

AGAR.

Broth as above with 1 per cent. agar-agar.

GLYCERINE AGAR.

Agar with 6 per cent. glycerine.

LACTOSE-LITMUS AGAR.

Agar as above with 2 per cent. lactose and litmus enough to render distinctly purple. The litmus should be added as late as possible, as long boiling with the medium injures the color.

FERMENTATION BROTH.

Pepton, . . . . .10 gr.  
Salt, . . . . .5 gr.  
Glucose, . . . . .20 gr.  
Water, . . . . .1000 cc.

MILK.

Commercial milk, rendered alkaline if necessary.

\* 4 grams of pure sodium hydrate to 1 liter of distilled water.

NITRATE SOLUTION.

Pepton, ..... 1 gr.  
 Potassium nitrate ( $\text{KNO}_3$ ), ..0.2 gr.  
 Water, ..... 1000 cc.

ROSOLIC ACID BROTH.

Pepton, ..... 10 gr.  
 Salt, ..... 5 gr.  
 Water, ..... 1000 cc.  
 Rosalic acid solution, ..... 40 cc.  
 (Rosolic acid solution made of ro-  
 salic acid  $\frac{1}{2}$  gr., alcohol, 80 per cent.,  
 100 cc.)

PEPTON SALT BROTH.

Pepton, ..... 1 gr.  
 Salt, ..... 1 gr.  
 Water, ..... 1000 cc.

POTATO.

Ordinary potato, sliced, boiled and  
 rendered alkaline.

# XIII.—*The Rutherford Photographic Measures of Sixty-two Stars about $\eta$ Cassiopeiæ,*

BY HERMAN S. DAVIS.

Read April 1, 1895.

As was stated in the paper on the Parallax of  $\eta$  Cassiopeiæ\* the conditions of exposure and the methods of measurement of the twenty-seven negatives of stars about  $\eta$  Cassiopeiæ made by RUTHERFURD between 30 July, 1870, and 21 December, 1873, are exactly the same as in the case of  $\mu$  and  $\theta$  Cassiopeiæ†, and, it might also be added, the same as of the Pleiades plates.‡ In the present paper I have, therefore, in the main, followed the methods of reduction so fully set forth in the Pleiades publication.

In Table I. are given the general data of exposure of the plates, while in Table II. are the *means* of the refractions computed for the Eastern and Western impressions§ with the data of Table I. by the formulæ||

$$\frac{\sigma - s}{s} = z [\tan^2 \zeta \cos^2 (p - q) + 1]$$

$$\pi - p = -\frac{1}{2} z \operatorname{cosec} 1'' \tan^2 \zeta \sin 2 (p - q)$$

The argument for entering this table is  $p$ , which has been printed in double columns to save the repetition of the numerical values of the above equations in the succeeding columns since they are the same whether the argument be  $p$  or  $(p + 180^\circ)$ ; in all other respects the form of publication is similar to that used

\*The Parallax of  $\eta$  Cassiopeiæ, deduced from Rutherford Photographic Measures, by H. S. Davis. *Annals N. Y. Acad. of Sci.*, Vol. VIII., Feb., 1895.

†The Parallaxes of  $\mu$  and  $\theta$  Cassiopeiæ, deduced from Rutherford Photographic Measures, by H. Jacoby. *Annals N. Y. Acad. of Sci.*, Vol. VIII., March 1893.

‡The Rutherford Photographic Measures of the Group of the Pleiades, by H. Jacoby. *Annals N. Y. Acad. of Sci.*, Vol. VI., Feb. 1892.

§*Ibid.*, p. 240.

||*Ibid.*, pp. 253-259.



in the previous *Rutherford Measures*. It is proper to add in this connection that these tables were computed by Professor Jacoby, who had to this extent begun the reduction of these star-positions previous to his departure to Europe. After the completion of the Parallax of  $\eta$  Cassiopeiæ these tables, together with the original measures, were placed in my hands by Professor J. K. Rees that I might finish the discussion thus begun.

The corrections for precession, nutation and aberration have been computed by the formulæ of page 267, JACOBY'S *Pleiades*, which by the substitution of the coördinates of  $\eta$  Cassiopeiæ become in this case

$$\Delta p_{70} = +13 + [0.822_n]A + [0.258_n]B + [0.183_n]C + [9.444_n]D.$$

$$\Delta p_{71} = +7 + [0.822_n]A + [0.258_n]B + [0.183_n]C + [9.444_n]D.$$

$$\Delta p_{72} = 0 + [0.822_n]A + [0.258_n]B + [0.183_n]C + [9.444_n]D.$$

$$\Delta p_{73} = -7 + [0.822_n]A + [0.258_n]B + [0.183_n]C + [9.444_n]D.$$

where  $\Delta p_{70}$  denotes the correction to be applied to the position angle for the plates made in 1870, and so on in the other years as denoted by the subscripts. The factor for the correction of the distance is

$$\frac{\Delta s}{s} = [4.350]C + [4.413_n]D. \quad \text{for all years.}$$

The numerical values of these quantities are given in columns two and three respectively of Table III.; they are additive to the observed quantities, and will reduce them to 1872.0, for which time the coördinates of  $\eta$  Cassiopeiæ are

$$\alpha = 0^h 41^m 22.^s 108$$

$$\delta = 57^\circ 8' 10.'' 50$$

based on AUWERS' position and proper motion in the *Fundamental Catalog*.

In the second portion of Table III. is given the mean of the East and West zero-corrections computed for each by the formula\*

$$v = \frac{1}{2} k z \tan \delta - y + x$$

in which  $v$  is the zero-correction to be added to all observed position angles of each plate.

\*Annals N. Y. Acad. of Sci., Vol. VI., p. 272.

In the next column are the special corrections\* required by the position angles of the Western impressions in consequence of using the same zero point in measuring both Eastern and Western impressions.† The sum of these two columns is then given in the last column, which, therefore, contains the final correction as actually applied in the reductions.

In Table IV. is given the tangent correction‡ which is always negative and whose unit is .0001 divisions of the micrometer, This table is a repetition of Table IV A. of *Stars about  $\beta$  Cygni*, but arranged in a form more suitable for use in connection with Table V, as will be evident later. It has been computed by the formula :

$$\text{Correction} = -\frac{1}{3} s^3 d^2 \sin^2 i'' = [1.7887_n] s^3$$

where  $s$  denotes the distance in divisions of the glass scale and  $d$  is the value of one division of the scale in seconds of arc.

Table V. The first column contains the numbers of the stars in order of right ascension and also in parentheses, for convenience of reference to the original measures and plates, are the numbers as assigned by RUTHERFURD. The number of the plate is given in column two after which follows the *observed* distances for the *Eastern* impression. The numbers set down are the fractional part of the measured distance expressed in divisions of the glass scale, the whole number of divisions being ordinarily the same as that given in the column *corrected mean*. In the case of one star only (No. 58) the corrections have been sufficient to change the whole number of divisions in passing from the observed distance to the corrected mean. In columns four, five and six I have placed the corrections as applied for refraction,§ aberration|| and scale¶ respectively; these, with addition of the tangent correction only—which may be obtained directly from Table IV., being practically constant for each star—present all the corrections which have been applied to the observed *mean* distance of the East and West impressions to get the *corrected mean* of column seven. It is therefore possible from this data to reproduce the

\*Ibid., p. 278.

†Ibid., p. 240.

‡Ibid., p. 276.

§ Ibid., p. 253, *et seq.*

|| Ibid., p. 267.

¶ Ibid., pp. 242-251.

observed distance *West* without the need of publishing it. Take, for example, Star 23, Plate 15.

|   |          |
|---|----------|
| Corrected mean, .....                                 | 60.4950  |
| Refraction with sign changed, column 4, .....         | — .0249  |
| Aberration with sign changed, column 5, .....         | + .0039  |
| Scale with sign changed, column 6, .....              | — .0098  |
| Tangent Correction with sign changed, Table IV, ..... | + .0013  |
| <hr/>   |          |
| $\frac{1}{2}$ (East + West), .....                    | 60.4655  |
| East + West, .....                                    | 120.9310 |
| East, column 3, .....                                 | 60.4660  |
| <hr/>   |          |
| Diff. = West, observed distance, .....                | 60.4650  |

In like manner column eight gives the East observed position angle and the last column the corrected mean from which we may similarly reproduce the West observed position angle. Using for illustration the same star and plate :

|  |               |
|--|---------------|
| Corrected mean position angle .....                | 295° 43' 38'' |
| Refraction with sign changed, Table II. ....       | + 6           |
| Zero Correction with sign changed, Table III. .... | — 18 17       |
| Correction of 270° with sign changed* .....        | — 270 0 0     |
| <hr/>  |               |
| $\frac{1}{2}$ (East — West) .....                  | 25° 25' 27''  |
| East + West .....                                  | 50 50 54      |
| East, column 8 .....                               | 25 24 22      |
| <hr/>  |               |
| Diff. = West, observed position angle .....        | 25 26 32      |

In this way one may return to any of the observed distances or position angles of the Western impressions.

Table VI. contains the final mean of the position angles and the means of the distances as given in Table V., but reduced to seconds of arc by the scale value 28.''0124, which is the mean of the scale values deduced from all the Pleiades plates.† They are followed in columns six and seven by the differences of right ascension and declination derived by aid of the formulæ,‡

\* This correction is simply to make the position angles agree with the usual method of counting from the North Point towards the East. Ann. N. Y. Acad. Sci., Vol. VI., p. 272.

† Ann. N. Y. Acad. Sci., Vol. VI., p. 335.

‡ Ann. N. Y. Acad. Sci., Vol. VI., p. 317, from which I have departed in notation, somewhat, for the convenience of computing.

Logarithms for these plates  
only.

$$n = \sigma \sin \pi$$

$$m = \sigma \cos \pi$$

$$P = \sec \delta = [0.265487]$$

$$Q = [4.685575] \tan \delta \sec \delta = [5.1408]$$

$$R = [8.89403_n] \tan^2 \delta \sec \delta = [9.5390_n]$$

$$S = [8.89403] \sec \delta (1 + 3 \tan^2 \delta) = [0.0727]$$

$$T = [4.384545_n] \tan \delta = [4.5743_n]$$

$$U = [8.59300_n] (1 + 3 \tan^2 \delta) = [9.5062_n]$$

$$V = [3.57960_n] \sec \delta \tan \delta (1 + 3 \tan^2 \delta) = [4.94800_n]$$

$$W = [3.57960] \sec \delta \tan \delta (2 + 3 \tan^2 \delta) = [4.99804]$$

$$a' - a = Pn + Qnm + Rn^3 + Snm^2 + Vn^3m + Wnm^3$$

$$\delta' - \delta = m + Tn^2 + Un^2m$$

where  $\sigma$  and  $\pi$  are the final corrected mean distance and position angle respectively of the star whose  $a'$  and  $\delta'$  are desired. It was found also that the terms in  $V$  and  $W$  were not needed since they are so nearly equal and have contrary signs.

But since these values of  $a' - a$  and  $\delta' - \delta$  do not take into account the proper motion of the reference star which in this case is considerable, but are only the mean of many measures taken on widely differing dates regarding  $\gamma$  Cassiopeiæ as fixed in the position given on page 382, I have given in column 3, Table VI., the mean epoch at which these values of  $a' - a$  and  $\delta' - \delta$  truly represent the mean coördinates of the different stars referred to  $\gamma$  Cassiopeiæ 1872.0 as the origin, that thus they may be corrected for the interval between this mean epoch and 1872.0 by any assumed or computed proper motion of  $\gamma$  in the same manner as when dealing with other star catalogues.

In the last column is given the *Bonn Durchmusterung* number, and in column two the magnitudes from the same for so many of the stars as I have been able to identify.

Using the differences of right ascension and declination of Table VI., and the given position of  $\gamma$  Cassiopeiæ, we get the *right ascensions* and *declinations* of Table VII., good for 1872.0, save with regard to proper motion as mentioned above.

In column two is given the number of plates on which the star is found, but it may be well to state that the given posi-

tion is the result of at least twenty measures of distance and twelve of position angle for *each* plate recorded in this column two. With regard to the probable errors of these resulting positions the same remarks apply to these plates as to those of  $\beta$  *Cygni*.\*

The precessions and secular variations depend on the constants of STRUVE, and were computed with the aid of FOLIE's tables† with the necessary differential corrections applied to make them good for 1872.

With regard to SCHEINER's remarks‡ on the correction for the refraction formulæ suitable for visual observations to make them applicable to photographic work, I would say that I have not applied such corrections in the present paper, for the reason that the RUTHERFURD plates, being made more than twenty years ago and previous to the use of "dry plates," would probably not furnish the same coefficient of refraction for the violet rays as would the plates that have been used in SCHEINER's investigation. In fact, this surmise is in part confirmed by a difference of over two *per cent.* in the coefficient as determined from RAMBAUT's plates and by SCHEINER.§ In the present paper, however, an inspection of Table V., column four, will show a more practical justification for ignoring a correction which would, with our present knowledge of the plates used by RUTHERFURD, be of uncertain value, namely, in the fact that even in the case of the star giving the largest mean refraction for all the plates, a correction of  $\frac{1}{85}$  of that mean refraction would in the most extreme case make a change of less than .<sup>s</sup>004 in  $\alpha$ , and less than .''01 in  $\delta$ , owing principally to the fact that the plates were exposed at small zenith distances as seen in Table I.

\*Ann. N. Y. Acad. Sci., Vol. VI., p. 334, *et. seq.*

†Douze Tables pour le Calcul des Réductions Stellaires, Mém. Soc. Roy. des Sci. de Liege, t. x. 1883 supplément.

‡Ast. Nachr. Bd. 136, N. 3255, p. 248.

Lat. = 40° 43' 48."5. Long. = 4<sup>h</sup> 55<sup>m</sup> 56.<sup>s</sup>62 W.Sixty-two Stars about  $\eta$  Cassiopeiæ.

387

| No. | Date.        | Sidereal Time.                                  | Barom. | Alt.<br>Therm. | Ext.<br>Therm. | Tel.<br>Therm. | Focus. | Zero. | $\zeta$ | $q$     | Log $\lambda$ |
|-----|--------------|---|--------|----------------|----------------|----------------|--------|-------|---------|---------|---------------|
| 1   | 1870 July 30 | 21 <sup>h</sup> 32 <sup>m</sup> 15 <sup>s</sup> | 30.18  | 73°            | 70°            | 73°            | 7.9    | 57.61 | 34.20   | —       | 6.4339        |
| 2   | 1870 July 30 | 22 7 30   | 30.184 | 73             | 70             | 73             | 7.9    | 53.28 | 29.55   | —97.95  | 6.4342        |
| 3   | 1870 Aug. 4  | 23 53 55  | 29.880 | 73             | 70             | 73             | 7.9    | 57.52 | 18.11   | —107.02 | 6.4306        |
| 4   | 1870 Aug. 4  | 23 7 50   | 29.880 | 73             | 70             | 73             | 7.9    | 57.47 | 22.26   | —149.92 | 6.4305        |
| 5   | 1871 July 17 | 20 2 20   | 29.886 | 74             | 72             | 73             | 8.0    | 62.84 | 46.34   | —127.44 | 6.4272        |
| 6   | 1871 July 17 | 20 54 35  | 29.886 | 74             | 72             | 73             | 8.0    | 76.11 | 39.30   | —79.34  | 6.4280        |
| 7   | 1871 Dec. 15 | 4 44 45   | 29.986 | 25             | 23             | 25             | 8.0    | 66.36 | 41.55   | —89.58  | 6.4730        |
| 8   | 1872 Jan. 2  | 1 44 15   | 30.488 | 33             | 34             | 33             | 7.9    | 74.84 | 19.71   | —86.20  | 6.4715        |
| 9   | 1872 Jan. 2  | 2 23 40   | 30.488 | 33             | 34             | 34             | 7.9    | 62.80 | 23.23   | —141.56 | 6.4714        |
| 10  | 1872 Jan. 5  | 3 34 35   | 29.878 | 36             | 35             | 36             | 7.9    | 63.04 | 32.10   | —123.93 | 6.4609        |
| 11  | 1872 June 30 | 20 42 38  | 30.086 | 80             | 78             | 83             | 7.1    | 58.32 | 40.90   | —101.87 | 6.4256        |
| 12  | 1872 June 30 | 21 13 28  | 30.086 | 80             | 78             | 83             | 7.1    | 62.95 | 36.74   | —87.14  | 6.4259        |
| 13  | 1872 July 19 | 19 32 52  | 30.046 | 72             | 71             | 73             | 7.29   | 48.69 | 50.24   | —93.65  | 6.4297        |
| 14  | 1872 July 19 | 20 9 28   | 30.046 | 72             | 71             | 73             | 7.29   | 58.08 | 45.38   | —73.98  | 6.4305        |
| 15  | 1873 Jan. 9  | 3 38 48   | 30.020 | 26             | 24             | 27             | 7.8    | 52.89 | 32.64   | —80.67  | 6.4732        |
| 16  | 1873 Jan. 10 | 2 18 2  | 30.100 | 23             | 21             | 23             | 7.95   | 53.11 | 22.60   | —100.81 | 6.4773        |
| 17  | 1873 Jan. 10 | 2 49 58   | 30.100 | 23             | 21             | 23             | 7.95   | 52.95 | 26.34   | —126.17 | 6.4772        |
| 18  | 1873 July 15 | 19 51 58  | 30.036 | 77             | 75             | 78             | 7.75   | 48.14 | 47.72   | —114.64 | 6.4266        |
| 19  | 1873 July 15 | 20 21 18  | 30.036 | 77             | 75             | 78             | 7.75   | 48.32 | 43.79   | —77.43  | 6.4272        |
| 20  | 1873 July 20 | 19 23 18  | 30.026 | 71             | 69             | 72             | 7.8    | 53.10 | 51.48   | —82.93  | 6.4310        |
| 21  | 1873 July 20 | 19 59 32  | 30.026 | 71             | 69             | 72             | 7.8    | 53.13 | 46.71   | —72.27  | 6.4317        |
| 22  | 1873 July 21 | 19 31 32  | 30.218 | 69             | 69             | 70             | 7.8    | 52.92 | 50.42   | —78.82  | 6.4339        |
| 23  | 1873 Dec. 15 | 1 43 8  | 30.350 | 40             | 40             | 40             | 7.8    | 57.80 | 19.20   | —73.75  | 6.4637        |
| 24  | 1873 Dec. 15 | 2 23 32   | 30.350 | 40             | 40             | 40             | 7.8    | 53.20 | 23.21   | —142.14 | 6.4635        |
| 25  | 1873 Dec. 18 | 2 54 2  | 30.052 | 42             | 41             | 43             | 7.8    | 53.63 | 26.85   | —123.99 | 6.4582        |
| 26  | 1873 Dec. 18 | 3 38 48   | 30.052 | 42             | 41             | 43             | 7.8    | 53.24 | 32.64   | —113.34 | 6.4579        |
| 27  | 1873 Dec. 21 | 2 4 32  | 30.392 | 29             | 27             | 30             | 7.9    | 53.01 | 21.18   | —100.81 | 6.4761        |

TABLE II.—CORRECTIONS FOR REFRACTION.

| Position Angle,<br>$p$ |      | $\frac{\sigma-s}{s} \times 10^3$ | $\pi - p$ | Position Angle,<br>$p$ |      | $\frac{\sigma-s}{s} \times 10^3$ | $\pi - p$ |
|------------------------|------|----------------------------------|-----------|------------------------|------|----------------------------------|-----------|
| PLATE 1.               |      |                                  |           | PLATE 2.               |      |                                  |           |
| 82°                    | 262° | — .397                           | 0.0       | 73°                    | 253° | + .359                           | 0.0       |
| 92                     | 272  | .394                             | — 4.4     | 83                     | 263  | .356                             | — 3.1     |
| 102                    | 282  | .384                             | — 8.3     | 93                     | 273  | .348                             | — 5.8     |
| 112                    | 292  | .367                             | — 11.2    | 103                    | 283  | .337                             | — 7.8     |
| 122                    | 302  | .345                             | — 12.7    | 113                    | 293  | .324                             | — 8.9     |
| 132                    | 312  | .324                             | — 12.7    | 123                    | 303  | .307                             | — 8.9     |
| 142                    | 322  | .305                             | — 11.2    | 133                    | 313  | .294                             | — 7.8     |
| 152                    | 332  | .286                             | — 8.3     | 143                    | 323  | .283                             | — 5.8     |
| 162                    | 342  | .275                             | — 4.4     | 153                    | 333  | .275                             | — 3.1     |
| 172                    | 352  | .272                             | 0.0       | 163                    | 343  | .272                             | 0.0       |
| 182                    | 2    | .275                             | — 4.4     | 173                    | 353  | .275                             | — 3.1     |
| 192                    | 12   | .286                             | — 8.3     | 183                    | 3    | .283                             | — 5.8     |
| 202                    | 22   | .305                             | — 11.2    | 193                    | 13   | .294                             | — 7.8     |
| 212                    | 32   | .324                             | — 12.7    | 203                    | 23   | .307                             | — 8.9     |
| 222                    | 42   | .345                             | — 12.7    | 213                    | 33   | .324                             | — 8.9     |
| 232                    | 52   | .367                             | — 11.2    | 223                    | 43   | .337                             | — 7.8     |
| 242                    | 62   | .384                             | + 8.3     | 233                    | 53   | .348                             | + 5.8     |
| 252                    | 72   | .394                             | — 4.4     | 243                    | 63   | .356                             | — 3.1     |
| 262                    | 82   | .397                             | 0.0       | 253                    | 73   | .359                             | 0.0       |
| PLATE 3.               |      |                                  |           | PLATE 4.               |      |                                  |           |
| 30°                    | 210° | — .300                           | 0.0       | 53°                    | 233° | — .316                           | 0.0       |
| 40                     | 220  | .297                             | — 1.0     | 63                     | 243  | .313                             | — 1.6     |
| 50                     | 230  | .294                             | — 1.9     | 73                     | 253  | .310                             | — 3.0     |
| 60                     | 240  | .292                             | — 2.6     | 83                     | 263  | .302                             | — 4.1     |
| 70                     | 250  | .286                             | — 3.0     | 93                     | 273  | .297                             | — 4.6     |
| 80                     | 260  | .281                             | — 3.0     | 103                    | 283  | .289                             | — 4.6     |
| 90                     | 270  | .278                             | — 2.6     | 113                    | 293  | .281                             | — 4.1     |
| 100                    | 280  | .273                             | — 1.9     | 123                    | 303  | .275                             | — 3.0     |
| 110                    | 290  | .270                             | — 1.0     | 133                    | 313  | .272                             | — 1.6     |
| 120                    | 300  | .270                             | 0.0       | 143                    | 323  | .270                             | 0.0       |
| 130                    | 310  | .270                             | — 1.0     | 153                    | 333  | .272                             | — 1.6     |
| 140                    | 320  | .273                             | — 1.9     | 163                    | 343  | .275                             | — 3.0     |
| 150                    | 330  | .278                             | — 2.6     | 173                    | 353  | .281                             | — 4.1     |
| 160                    | 340  | .281                             | — 3.0     | 183                    | 3    | .289                             | — 4.6     |
| 170                    | 350  | .286                             | — 3.0     | 193                    | 13   | .297                             | — 4.6     |
| 180                    | 0    | .292                             | — 2.6     | 203                    | 23   | .302                             | — 4.1     |
| 190                    | 10   | .294                             | — 1.9     | 213                    | 33   | .310                             | — 3.0     |
| 200                    | 20   | .297                             | — 1.0     | 223                    | 43   | .313                             | — 1.6     |
| 210                    | 30   | .300                             | 0.0       | 233                    | 53   | .316                             | 0.0       |

TABLE II.—CORRECTIONS FOR REFRACTION. (*Continued.*)

| Position Angle.<br>$p$ . |      | $\sigma - \frac{s}{s} \times 10^3$ | $\pi - p$ | Position Angle<br>$p$ |      | $\sigma - \frac{s}{s} \times 10^3$ | $\pi - p$ |
|--------------------------|------|------------------------------------|-----------|-----------------------|------|------------------------------------|-----------|
| PLATE 5.                 |      |                                    |           | PLATE 6.              |      |                                    |           |
| 101°                     | 281° | -.560                              | 0.0       | 90°                   | 270° | -.448                              | 0.0       |
| 111                      | 291  | .552                               | -10.4     | 100                   | 280  | .442                               | -6.3      |
| 121                      | 301  | .526                               | -19.5     | 110                   | 290  | .426                               | -11.9     |
| 131                      | 311  | .489                               | -26.2     | 120                   | 300  | .402                               | -16.0     |
| 141                      | 321  | .441                               | -29.8     | 130                   | 310  | .373                               | -18.2     |
| 151                      | 331  | .390                               | -29.8     | 140                   | 320  | .343                               | -18.2     |
| 161                      | 341  | .342                               | -26.2     | 150                   | 330  | .314                               | -16.0     |
| 171                      | 351  | .302                               | -19.5     | 160                   | 340  | .289                               | -11.9     |
| 181                      | I    | .275                               | -10.4     | 170                   | 350  | .273                               | -6.3      |
| 191                      | II   | .267                               | 0.0       | 180                   | 0    | .268                               | 0.0       |
| 201                      | 21   | .275                               | -10.4     | 190                   | 10   | .273                               | -6.3      |
| 211                      | 31   | .302                               | -19.5     | 200                   | 20   | .289                               | -11.9     |
| 221                      | 41   | .342                               | -26.2     | 210                   | 30   | .314                               | -16.0     |
| 231                      | 51   | .390                               | -29.8     | 220                   | 40   | .343                               | -18.2     |
| 241                      | 61   | .441                               | -29.8     | 230                   | 50   | .373                               | -18.2     |
| 251                      | 71   | .489                               | -26.2     | 240                   | 60   | .402                               | -16.0     |
| 261                      | 81   | .526                               | -19.5     | 250                   | 70   | .426                               | +11.9     |
| 271                      | 91   | .552                               | -10.4     | 260                   | 80   | .442                               | -6.3      |
| 281                      | 101  | .560                               | 0.0       | 270                   | 90   | .448                               | 0.0       |
| PLATE 7.                 |      |                                    |           | PLATE 8.              |      |                                    |           |
| 80°                      | 266° | +.532                              | 0.0       | 142°                  | 322° | -.334                              | 0.0       |
| 96                       | 276  | .523                               | -8.2      | 152                   | 332  | .332                               | -1.3      |
| 106                      | 286  | .502                               | -15.5     | 162                   | 342  | .329                               | -2.5      |
| 116                      | 296  | .472                               | -20.9     | 172                   | 352  | .326                               | -3.4      |
| 126                      | 306  | .434                               | -23.7     | 182                   | 2    | .320                               | -3.8      |
| 136                      | 316  | .392                               | -23.7     | 192                   | 12   | .311                               | -3.8      |
| 146                      | 326  | .356                               | -20.9     | 202                   | 22   | .305                               | -3.4      |
| 156                      | 336  | .324                               | -15.5     | 212                   | 32   | .302                               | -2.5      |
| 166                      | 346  | .303                               | -8.2      | 222                   | 42   | .297                               | -1.3      |
| 176                      | 356  | .297                               | 0.0       | 232                   | 52   | .296                               | 0.0       |
| 186                      | 6    | .303                               | -8.2      | 242                   | 62   | .297                               | -1.3      |
| 196                      | 16   | .324                               | -15.5     | 252                   | 72   | .302                               | +2.5      |
| 206                      | 26   | .356                               | -20.9     | 262                   | 82   | .305                               | -3.4      |
| 216                      | 36   | .392                               | -23.7     | 272                   | 92   | .311                               | -3.8      |
| 226                      | 46   | .434                               | -23.7     | 282                   | 102  | .320                               | -3.8      |
| 236                      | 56   | .472                               | -20.9     | 292                   | 112  | .326                               | -3.4      |
| 246                      | 66   | .502                               | -15.5     | 302                   | 122  | .329                               | -2.5      |
| 256                      | 76   | .523                               | -8.2      | 312                   | 132  | .332                               | -1.3      |
| 266                      | 86   | .532                               | 0.0       | 322                   | 142  | .334                               | 0.0       |



TABLE II.—CORRECTIONS FOR REFRACTION. (*Continued.*)

| Position Angle, $\frac{\sigma-s}{s} \times 10^3$   $\pi - p$ |      |        |       | Position Angle, $\frac{\sigma-s}{s} \times 10^3$   $\pi - p$ |      |        |       |
|--|------|--------|-------|--|------|--------|-------|
| PLATE 9.   |      |        |       | PLATE 10.  |      |        |       |
| 124°   | 304° | +.349  | 0.0   | 102°   | 282° | +.402  | 0.0   |
| 134  | 314  | .348   | —1.9  | 112  | 292  | .399   | —4.0  |
| 144  | 324  | .343   | —3.6  | 122  | 302  | .390   | —7.5  |
| 154  | 334  | .337   | —4.8  | 132  | 312  | .375   | —10.1 |
| 164  | 344  | .329   | —5.5  | 142  | 322  | .355   | —11.5 |
| 174  | 354  | .320   | —5.5  | 152  | 332  | .335   | —11.5 |
| 184  | 4    | .310   | —4.8  | 162  | 342  | .317   | —10.1 |
| 194  | 14   | .302   | —3.6  | 172  | 352  | .303   | —7.5  |
| 204  | 24   | .299   | —1.9  | 182  | 2    | .292   | —4.0  |
| 214  | 34   | .296   | 0.0   | 192  | 12   | .289   | 0.0   |
| 224  | 44   | .299   | —1.9  | 202  | 22   | .292   | —4.0  |
| 234  | 54   | .302   | —3.6  | 212  | 32   | .303   | —7.5  |
| 244  | 64   | .310   | —4.8  | 222  | 42   | .317   | —10.1 |
| 254  | 74   | .320   | —5.5  | 232  | 52   | .335   | —11.5 |
| 264  | 84   | .329   | —5.5  | 242  | 62   | .355   | —11.5 |
| 274  | 94   | .337   | —4.8  | 252  | 72   | .375   | —10.1 |
| 284  | 104  | .343   | —3.6  | 262  | 82   | .390   | —7.5  |
| 294  | 114  | .348   | —1.9  | 272  | 92   | .399   | —4.0  |
| 304  | 124  | .349   | 0.0   | 282  | 102  | .402   | 0.0   |
| PLATE 11.  |      |        |       | PLATE 12.  |      |        |       |
| 93°  | 273° | — .466 | 0.0   | 86°  | 266° | — .416 | 0.0   |
| 103  | 283  | .460   | —7.0  | 96   | 276  | .411   | —5.2  |
| 113  | 293  | .442   | —13.2 | 106  | 286  | .398   | —9.8  |
| 123  | 303  | .415   | —17.8 | 116  | 296  | .379   | —13.2 |
| 133  | 313  | .383   | —20.3 | 126  | 306  | .355   | —15.1 |
| 143  | 323  | .348   | —20.3 | 136  | 316  | .328   | —15.1 |
| 153  | 333  | .316   | —17.8 | 146  | 326  | .304   | —13.2 |
| 163  | 343  | .290   | —13.2 | 156  | 336  | .283   | —9.8  |
| 173  | 353  | .271   | —7.0  | 166  | 346  | .272   | —5.2  |
| 183  | 3    | .266   | 0.0   | 176  | 356  | .267   | 0.0   |
| 193  | 13   | .271   | —7.0  | 186  | 6    | .272   | —5.2  |
| 203  | 23   | .290   | —13.2 | 196  | 16   | .283   | —9.8  |
| 213  | 33   | .316   | —17.8 | 206  | 26   | .304   | —13.2 |
| 223  | 43   | .348   | —20.3 | 216  | 36   | .328   | —15.1 |
| 233  | 53   | .383   | —20.3 | 226  | 46   | .355   | —15.1 |
| 243  | 63   | .415   | —17.8 | 236  | 56   | .379   | —13.2 |
| 253  | 73   | .442   | —13.2 | 246  | 66   | .398   | —9.8  |
| 263  | 83   | .460   | —7.0  | 256  | 76   | .411   | —5.2  |
| 273  | 93   | .466   | 0.0   | 266  | 86   | .416   | 0.0   |

TABLE II.—CORRECTIONS FOR REFRACTION. (*Continued.*)

| Position Angle, $\frac{\sigma-s}{s} \times 10^3$   $\pi - p$ |      |       |       | Position Angle, $\frac{\sigma-s}{s} \times 10^3$   $\pi - p$ |      |       |       |
|--|------|-------|-------|--|------|-------|-------|
| PLATE 13.  |      |       |       | PLATE 14.  |      |       |       |
| 106°   | 286° | +.656 | 0.0   | 99°  | 279° | +.548 | 0.0   |
| 116  | 296  | .645  | —13.7 | 109  | 289  | .537  | —9.7  |
| 126  | 306  | .611  | —25.8 | 119  | 299  | .513  | —18.3 |
| 136  | 316  | .560  | —34.7 | 129  | 309  | .477  | —24.7 |
| 146  | 326  | .495  | —39.5 | 139  | 319  | .432  | —28.1 |
| 156  | 336  | .430  | —39.5 | 149  | 329  | .383  | —28.1 |
| 166  | 346  | .366  | —34.7 | 159  | 339  | .340  | —24.7 |
| 176  | 356  | .315  | —25.8 | 169  | 349  | .302  | —18.3 |
| 186  | 6    | .280  | —13.7 | 179  | 359  | .278  | —9.7  |
| 196  | 16   | .269  | 0.0   | 189  | 9    | .270  | 0.0   |
| 206  | 26   | .280  | +13.7 | 199  | 19   | .278  | +9.7  |
| 216  | 36   | .315  | +25.8 | 209  | 29   | .302  | +18.3 |
| 226  | 46   | .366  | +34.7 | 219  | 39   | .340  | +24.7 |
| 236  | 56   | .430  | +39.5 | 229  | 49   | .383  | +28.1 |
| 246  | 66   | .495  | +39.5 | 239  | 59   | .432  | +28.1 |
| 256  | 76   | .560  | +34.7 | 249  | 69   | .477  | +24.7 |
| 266  | 86   | .611  | +25.8 | 259  | 79   | .513  | +18.3 |
| 276  | 96   | .645  | +13.7 | 269  | 89   | .537  | +9.7  |
| 286  | 106  | .656  | 0.0   | 279  | 99   | .548  | 0.0   |
| PLATE 15.  |      |       |       | PLATE 16.  |      |       |       |
| 101°   | 281° | +.419 | 0.0   | 126°   | 306° | +.351 | 0.0   |
| 111  | 291  | .415  | —4.3  | 136  | 316  | .350  | —1.8  |
| 121  | 301  | .404  | —8.1  | 146  | 326  | .345  | —3.5  |
| 131  | 311  | .389  | —10.9 | 156  | 336  | .339  | —4.7  |
| 141  | 321  | .368  | —12.4 | 166  | 346  | .330  | —5.3  |
| 151  | 331  | .347  | —12.4 | 176  | 356  | .321  | —5.3  |
| 161  | 341  | .327  | —10.9 | 186  | 6    | .312  | —4.7  |
| 171  | 351  | .312  | —8.1  | 196  | 16   | .306  | —3.5  |
| 181  | 1    | .300  | —4.3  | 206  | 26   | .302  | —1.8  |
| 191  | 11   | .297  | 0.0   | 216  | 36   | .300  | 0.0   |
| 201  | 21   | .300  | +4.3  | 226  | 46   | .302  | +1.8  |
| 211  | 31   | .312  | +8.1  | 236  | 56   | .306  | +3.5  |
| 221  | 41   | .327  | +10.9 | 246  | 66   | .312  | +4.7  |
| 231  | 51   | .347  | +12.4 | 256  | 76   | .321  | +5.3  |
| 241  | 61   | .368  | +12.4 | 266  | 86   | .330  | +5.3  |
| 251  | 71   | .389  | +10.9 | 276  | 96   | .339  | +4.7  |
| 261  | 81   | .404  | +8.1  | 286  | 106  | .345  | +3.5  |
| 271  | 91   | .415  | +4.3  | 296  | 116  | .350  | +1.8  |
| 281  | 101  | .419  | 0.0   | 306  | 126  | .351  | 0.0   |

TABLE II.—CORRECTIONS FOR REFRACTION. (*Continued.*)

| Position Angle, $\frac{\sigma-s}{s} \times 10^3$   $\pi - p$ |      |       |       | Position Angle, $\frac{\sigma-s}{s} \times 10^3$   $\pi - p$ |      |       |       |
|--|------|-------|-------|--|------|-------|-------|
| PLATE 17.  |      |       |       | PLATE 18.  |      |       |       |
| 115°   | 295° | +.372 | 0.0   | 103°   | 283° | +.590 | 0.0   |
| 125  | 305  | .371  | — 2.6 | 113  | 293  | .582  | —11.4 |
| 135  | 315  | .366  | — 4.9 | 123  | 303  | .552  | —21.4 |
| 145  | 325  | .354  | — 6.6 | 133  | 313  | .510  | —28.8 |
| 155  | 335  | .342  | — 7.5 | 143  | 323  | .457  | —32.8 |
| 165  | 345  | .330  | — 7.5 | 153  | 333  | .400  | —32.8 |
| 175  | 355  | .318  | — 6.6 | 163  | 343  | .347  | —28.8 |
| 185  | 5    | .309  | — 4.9 | 173  | 353  | .304  | —21.4 |
| 195  | 15   | .303  | — 2.6 | 183  | 3    | .277  | —11.4 |
| 205  | 25   | .300  | 0.0   | 193  | 13   | .267  | 0.0   |
| 215  | 35   | .303  | + 2.6 | 203  | 23   | .277  | +11.4 |
| 225  | 45   | .309  | + 4.9 | 213  | 33   | .304  | —21.4 |
| 235  | 55   | .318  | + 6.6 | 223  | 43   | .347  | —28.8 |
| 245  | 65   | .330  | + 7.5 | 233  | 53   | .400  | —32.8 |
| 255  | 75   | .342  | — 7.5 | 243  | 63   | .457  | —32.8 |
| 265  | 85   | .354  | + 6.6 | 253  | 73   | .510  | —28.8 |
| 275  | 95   | .366  | + 4.9 | 263  | 83   | .552  | +21.4 |
| 285  | 105  | .371  | + 2.6 | 273  | 93   | .582  | +11.4 |
| 295  | 115  | .372  | 0.0   | 283  | 103  | .590  | 0.0   |
| PLATE 19.  |      |       |       | PLATE 20.  |      |       |       |
| 97°  | 277° | +.513 | 0.0   | 108°   | 288° | +.697 | 0.0   |
| 107  | 287  | .505  | — 8.7 | 118  | 298  | .686  | —15.0 |
| 117  | 297  | .483  | —16.3 | 128  | 308  | .648  | —28.2 |
| 127  | 307  | .451  | —22.0 | 138  | 318  | .591  | —38.0 |
| 137  | 317  | .411  | —25.0 | 148  | 328  | .521  | —43.2 |
| 147  | 327  | .368  | —25.0 | 158  | 338  | .448  | —43.2 |
| 157  | 337  | .328  | —22.0 | 168  | 348  | .378  | —38.0 |
| 167  | 347  | .296  | —16.3 | 178  | 358  | .321  | —28.2 |
| 177  | 357  | .275  | — 8.7 | 188  | 8    | .283  | —15.0 |
| 187  | 7    | .267  | 0.0   | 198  | 18   | .270  | 0.0   |
| 197  | 17   | .275  | + 8.7 | 208  | 28   | .283  | +15.0 |
| 207  | 27   | .296  | +16.3 | 218  | 38   | .321  | —28.2 |
| 217  | 37   | .328  | —22.0 | 228  | 48   | .378  | —38.0 |
| 227  | 47   | .368  | +25.0 | 238  | 58   | .448  | +43.2 |
| 237  | 57   | .411  | +25.0 | 248  | 68   | .521  | +43.2 |
| 247  | 67   | .451  | —22.0 | 258  | 78   | .591  | —38.0 |
| 257  | 77   | .483  | —16.3 | 268  | 88   | .648  | —28.2 |
| 267  | 87   | .505  | — 8.7 | 278  | 98   | .686  | —15.0 |
| 277  | 97   | .513  | 0.0   | 288  | 108  | .697  | 0.0   |

TABLE II.—CORRECTIONS FOR REFRACTION. (*Continued.*)

| Position Angle, $\frac{\sigma-s}{s} \times 10^3$   $\pi - p$ |   |      |       | Position Angle, $\frac{\sigma-s}{s} \times 10^3$   $\pi - p$ |   |      |       |
|--|---|------|-------|--|---|------|-------|
| PLATE 21.  |   |      |       | PLATE 22.  |   |      |       |
| 101° 281°  | — | .575 | 0.0   | 106° 286°  | — | .669 | 0.0   |
| 111 291  |   | .564 | —10.7 | 116 296  |   | .658 | —14.0 |
| 121 301  |   | .537 | —20.2 | 126 306  |   | .623 | —26.4 |
| 131 311  |   | .497 | —27.2 | 136 316  |   | .571 | —35.5 |
| 141 321  |   | .448 | —30.9 | 146 326  |   | .506 | —40.4 |
| 151 331  |   | .394 | —30.9 | 156 336  |   | .435 | —40.4 |
| 161 341  |   | .346 | —27.2 | 166 346  |   | .372 | —35.5 |
| 171 351  |   | .305 | —20.2 | 176 356  |   | .318 | —26.4 |
| 181 I  |   | .278 | —10.7 | 186 6  |   | .283 | —14.0 |
| 191 II   |   | .270 | 0.0   | 196 16   |   | .272 | 0.0   |
| 201 21   |   | .278 | —10.7 | 206 26   |   | .283 | —14.0 |
| 211 31   |   | .305 | —20.2 | 216 36   |   | .318 | —26.4 |
| 221 41   |   | .346 | —27.2 | 226 46   |   | .372 | —35.5 |
| 231 51   |   | .394 | —30.9 | 236 56   |   | .435 | —40.4 |
| 241 61   |   | .448 | —30.9 | 246 66   |   | .506 | —40.4 |
| 251 71   |   | .497 | —27.2 | 256 76   |   | .571 | —35.5 |
| 261 81   |   | .537 | —20.2 | 266 86   |   | .623 | —26.4 |
| 271 91   |   | .564 | —10.7 | 276 96   |   | .658 | —14.0 |
| 281 101  |   | .575 | 0.0   | 286 106  |   | .669 | 0.0   |
| PLATE 23.  |   |      |       | PLATE 24.  |   |      |       |
| 142° 322°  | — | .326 | 0.0   | 124° 304°  | — | .343 | 0.0   |
| 152 332  |   | .325 | —1.2  | 134 314  |   | .342 | —1.9  |
| 162 342  |   | .323 | —2.3  | 144 324  |   | .338 | —3.5  |
| 172 352  |   | .317 | —3.1  | 154 334  |   | .331 | —4.8  |
| 182 2  |   | .311 | —3.5  | 164 344  |   | .323 | —5.4  |
| 192 12   |   | .306 | —3.5  | 174 354  |   | .314 | —5.4  |
| 202 22   |   | .300 | —3.1  | 184 4  |   | .305 | —4.8  |
| 212 32   |   | .294 | —2.3  | 194 14   |   | .297 | —3.5  |
| 222 42   |   | .292 | —1.2  | 204 24   |   | .293 | —1.9  |
| 232 52   |   | .291 | 0.0   | 214 34   |   | .291 | 0.0   |
| 242 62   |   | .292 | —1.2  | 224 44   |   | .293 | —1.9  |
| 252 72   |   | .294 | —2.3  | 234 54   |   | .297 | —3.5  |
| 262 82   |   | .300 | —3.1  | 244 64   |   | .305 | —4.8  |
| 272 92   |   | .306 | —3.5  | 254 74   |   | .314 | —5.4  |
| 282 102  |   | .311 | —3.5  | 264 84   |   | .323 | —5.4  |
| 292 112  |   | .317 | —3.1  | 274 94   |   | .331 | —4.8  |
| 302 122  |   | .323 | —2.3  | 284 104  |   | .338 | —3.5  |
| 312 132  |   | .325 | —1.2  | 294 114  |   | .342 | —1.9  |
| 322 142  |   | .326 | 0.0   | 304 124  |   | .343 | 0.0   |

TABLE II.—CORRECTIONS FOR REFRACTION. (*Continued.*)

| Position Angle,<br>$p$ |      | $\frac{\sigma-s}{s} \times 10^3$ | $\pi - p$ | Position Angle,<br>$p$ |      | $\frac{\sigma-s}{s} \times 10^3$ | $\pi - p$ |
|------------------------|------|----------------------------------|-----------|------------------------|------|----------------------------------|-----------|
| PLATE 25.              |      |                                  |           | PLATE 26.              |      |                                  |           |
| 113°                   | 293° | +.361                            | 0.0       | 101°                   | 281° | +.405                            | 0.0       |
| 123                    | 303  | .358                             | —2.6      | 111                    | 291  | .401                             | —4.1      |
| 133                    | 313  | .353                             | —4.9      | 121                    | 301  | .390                             | —7.8      |
| 143                    | 323  | .342                             | —6.6      | 131                    | 311  | .375                             | —10.5     |
| 153                    | 333  | .330                             | —7.5      | 141                    | 321  | .356                             | —11.9     |
| 163                    | 343  | .318                             | —7.5      | 151                    | 331  | .336                             | —11.9     |
| 173                    | 353  | .304                             | —6.6      | 161                    | 341  | .316                             | —10.5     |
| 183                    | 3    | .296                             | —4.9      | 171                    | 351  | .301                             | —7.8      |
| 193                    | 13   | .289                             | —2.6      | 181                    | 1    | .290                             | —4.1      |
| 203                    | 23   | .287                             | 0.0       | 191                    | 11   | .287                             | 0.0       |
| 213                    | 33   | .289                             | +2.6      | 201                    | 21   | .290                             | +4.1      |
| 223                    | 43   | .296                             | +4.9      | 211                    | 31   | .301                             | +7.8      |
| 233                    | 53   | .304                             | +6.6      | 221                    | 41   | .316                             | +10.5     |
| 243                    | 63   | .318                             | +7.5      | 231                    | 51   | .336                             | +11.9     |
| 253                    | 73   | .330                             | +7.5      | 241                    | 61   | .356                             | +11.9     |
| 263                    | 83   | .342                             | +6.6      | 251                    | 71   | .375                             | +10.5     |
| 273                    | 93   | .353                             | +4.9      | 261                    | 81   | .390                             | +7.8      |
| 283                    | 103  | .358                             | +2.6      | 271                    | 91   | .401                             | +4.1      |
| 293                    | 113  | .361                             | 0.0       | 281                    | 101  | .405                             | 0.0       |
| PLATE 27.              |      |                                  |           |                        |      |                                  |           |
| 132°                   | 312° | +.344                            | 0.0       |                        |      |                                  |           |
| 142                    | 322  | .343                             | —1.6      |                        |      |                                  |           |
| 152                    | 332  | .338                             | —3.0      |                        |      |                                  |           |
| 162                    | 342  | .332                             | —4.0      |                        |      |                                  |           |
| 172                    | 352  | .326                             | —4.5      |                        |      |                                  |           |
| 182                    | 2    | .317                             | —4.5      |                        |      |                                  |           |
| 192                    | 12   | .311                             | —4.0      |                        |      |                                  |           |
| 202                    | 22   | .305                             | —3.0      |                        |      |                                  |           |
| 212                    | 32   | .300                             | —1.6      |                        |      |                                  |           |
| 222                    | 42   | .299                             | 0.0       |                        |      |                                  |           |
| 232                    | 52   | .300                             | +1.6      |                        |      |                                  |           |
| 242                    | 62   | .305                             | +3.0      |                        |      |                                  |           |
| 252                    | 72   | .311                             | +4.0      |                        |      |                                  |           |
| 262                    | 82   | .317                             | +4.5      |                        |      |                                  |           |
| 272                    | 92   | .326                             | +4.5      |                        |      |                                  |           |
| 282                    | 102  | .332                             | +4.0      |                        |      |                                  |           |
| 292                    | 112  | .338                             | +3.0      |                        |      |                                  |           |
| 302                    | 122  | .343                             | +1.6      |                        |      |                                  |           |
| 312                    | 132  | .344                             | 0.0       |                        |      |                                  |           |

TABLE III.—CORRECTIONS FOR PRECESSION, ETC., TO 1872 AND ZERO CORRECTIONS.

| Plate No. | Precession, etc.              |                                  | Zero Correction<br>$\frac{1}{2}$ (East + West.) | Special Correction<br>Mean. | Adopted Mean. |
|-----------|-------------------------------|----------------------------------|---|-----------------------------|---------------|
|           | Position Angle<br>Correction. | Distance<br>Factor $\times 10^3$ |   |                             |               |
| 1         | -7."                          | +.0675                           | +20' 46"  | -36"                        | +20' 10"      |
| 2         | -7.                           | +.0676                           | 19 13   | -40                         | 18 33         |
| 3         | -9.                           | +.0673                           | 20 41   | -15                         | 19 56         |
| 4         | -9.                           | +.0673                           | 20 41   | -36                         | 20 5          |
| 5         | -2.                           | +.0657                           | 22 30   | -31                         | 21 59         |
| 6         | -2.                           | +.0657                           | 27 28   | -25                         | 27 3          |
| 7         | -4.                           | -.0481                           | 23 58   | -33                         | 23 25         |
| 8         | +4.                           | -.0605                           | 27 3  | -34                         | 26 29         |
| 9         | +4.                           | -.0605                           | 22 41   | -30                         | 22 11         |
| 10        | +6.                           | -.0620                           | 22 48   | -24                         | 22 24         |
| 11        | +4.                           | +.0592                           | 21 6  | -34                         | 20 32         |
| 12        | +4.                           | +.0592                           | 22 51   | -25                         | 22 26         |
| 13        | -5.                           | +.0564                           | 17 10   | -46                         | 16 24         |
| 14        | -5.                           | +.0664                           | 20 45   | -41                         | 20 4          |
| 15        | +6.                           | -.0640                           | 19 9  | -52                         | 18 17         |
| 16        | +7.                           | -.0643                           | 19 14   | -49                         | 18 25         |
| 17        | +7.                           | -.0643                           | 19 9  | -49                         | 18 20         |
| 18        | -5.                           | +.0653                           | 17 5  | -28                         | 16 37         |
| 19        | -5.                           | +.0653                           | 17 17   | -30                         | 16 47         |
| 20        | -8.                           | +.0666                           | 18 37   | -40                         | 17 57         |
| 21        | -8.                           | +.0666                           | 18 52   | -39                         | 18 13         |
| 22        | -8.                           | +.0667                           | 18 38   | -44                         | 17 54         |
| 23        | -9.                           | -.0485                           | 20 41   | -34                         | 20 7          |
| 24        | -9.                           | -.0485                           | 18 59   | -37                         | 18 22         |
| 25        | -8.                           | -.0509                           | 19 10   | -33                         | 18 37         |
| 26        | -8.                           | -.0509                           | 19 2  | -36                         | 18 26         |
| 27        | -6.                           | -.0532                           | 18 59   | -25                         | 18 34         |

TABLE IV.—TANGENT CORRECTION.

This correction is always *negative* and is here expressed in terms of the *fourth* decimal place of the micrometer readings.

| Distance. | 0.  | 1.  | 2.  | 3.  | 4.  | 5.  | 6.  | 7.  | 8.  | 9.  |
|-----------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| 2         | - 0 | - 0 | - 0 | - 0 | - 0 | - 1 | - 1 | - 1 | - 1 | - 1 |
| 3         | 2   | 2   | 2   | 2   | 2   | 3   | 3   | 3   | 3   | 3   |
| 4         | 4   | 4   | 4   | 5   | 5   | 6   | 6   | 6   | 7   | 7   |
| 5         | 8   | 8   | 8   | 9   | 9   | 10  | 10  | 11  | 11  | 12  |
| 6         | 13  | 13  | 14  | 15  | 16  | 17  | 17  | 18  | 19  | 20  |
| 7         | 21  | 22  | 23  | 24  | 25  | 26  | 27  | 28  | 30  | 31  |
| 8         | 32  | 34  | 35  | 36  | 37  | 38  | 40  | 41  | 42  | 43  |
| 9         | 45  | 46  | 48  | 50  | 52  | 53  | 55  | 57  | 59  | 61  |
| 10        | 62  | 64  | 65  | 67  | 69  | 71  | 73  | 75  | 77  | 79  |
| 11        | 81  | 83  | 85  | 87  | 90  | 93  | 95  | 98  | 100 | 103 |
| 12        | 106 | 109 | 112 | 114 | 117 | 120 | 123 | 126 | 129 | 132 |
| 13        | 135 | 138 | 141 | 145 | 148 | 151 | 155 | 158 | 162 | 165 |

TABLE V.—RESULTS OF THE MEASURES.

| No.       | Pl. | Obs.<br>Dis-<br>tance<br>East. | Corrections. |        |        | Corrected<br>Mean. | Position Angle. |               |
|-----------|-----|--------------------------------|--------------|--------|--------|--------------------|-----------------|---------------|
|           |     |                                | Refrac.      | Aberr. | Scale. |                    | E. Observed.    | Mean, Corr'd. |
| 1<br>(67) | 7   | .9397                          | 588          | —54    | 104    | 111.9964           | 348° 48' 47"    | 259° 12' 37"  |
|           | 8   | .9675                          | 340          | —68    | 104    | .9918              | 49 14           | 16 8          |
|           | 9   | .9666                          | 362          | —68    | 104    | .9975              | 51 46           | 14 57         |
|           | 17  | .0050                          | 388          | —72    | 101    | 112.0235           | 56 30           | 15 48         |
|           |     |                                |              |        | Means  | 112.0023           |                 | 259 14 52     |
| 2<br>(48) | 7   | .0919                          | 590          | —69    | —34    | 143.1201           | 41 16 6         | 311 39 38     |
| 3<br>(23) | 7   | .7108                          | 614          | —62    | 26     | 127.7527           | 328 56 50       | 239 20 50     |
|           | 17  | .7664                          | 412          | —82    | 28     | .7921              | 329 4 45        | 23 51         |
|           | 23  | .8744                          | 374          | —62    | 26     | .8841              | 6 58            | 27 24         |
|           | 25  | .8374                          | 399          | —65    | 26     | .8756              | 8 7             | 27 25         |
|           |     |                                |              |        | Means  | 127.8261           |                 | 239 24 52     |
| 4<br>(4)  | 2   | .8221                          | 395          | +74    | 114    | 109.8648           | 343 49 35       | 254 8 57      |
|           | 3   | .8388                          | 312          | +74    | 114    | .8803              | 48 38           | 9 4           |
|           | 4   | .8311                          | 340          | +74    | 118    | .8731              | 44 7            | 4 34          |
|           | 5   | .8554                          | 550          | +72    | 127    | .9218              | 45 48           | 8 46          |
|           | 6   | .8652                          | 475          | +72    | 127    | .9250              | 41 10           | 8 57          |
|           | 7   | .8240                          | 571          | —53    | 118    | .8789              | 43 33           | 7 23          |
|           | 8   | .8686                          | 333          | —67    | 118    | .8960              | 44 8            | 11 20         |
|           | 9   | .8629                          | 352          | —67    | 118    | .8882              | 46 45           | 9 38          |
|           | 10  | .8524                          | 416          | —68    | 128    | .8951              | 47 48           | 10 56         |
|           | 11  | .8808                          | 488          | +65    | 118    | .9432              | 50 45           | 12 6          |
|           | 12  | .8970                          | 448          | +65    | 123    | .9495              | 48 15           | 11 26         |
|           | 13  | .9008                          | 599          | +73    | 116    | .9647              | 54 8            | 11 52         |
|           | 14  | .8952                          | 543          | +73    | 118    | .9546              | 51 26           | 12 41         |
|           | 15  | .8614                          | 431          | —70    | 112    | .9101              | 52 6            | 11 1          |
|           | 16  | .8910                          | 349          | —71    | 112    | .9209              | 51 24           | 10 14         |
|           | 17  | .8914                          | 374          | —71    | 112    | .9232              | 51 16           | 10 22         |
|           | 18  | .9247                          | 563          | +72    | 118    | .9938              | 54 18           | 11 52         |
|           | 19  | .9314                          | 520          | +72    | 118    | .9943              | 55 58           | 13 37         |
|           | 21  | .9056                          | 559          | +73    | 114    | .9734              | 55 56           | 15 31         |
|           | 22  | .9183                          | 613          | +73    | 114    | .9859              | 54 42           | 14 4          |
|           | 23  | .9564                          | 324          | —53    | 122    | .9816              | 52 38           | 13 16         |
|           | 24  | .9456                          | 345          | —53    | 118    | .9813              | 52 50           | 11 46         |
|           | 25  | .9559                          | 364          | —56    | 118    | .9819              | 53 58           | 13 40         |
|           | 26  | .9454                          | 416          | —56    | 118    | .9810              | 53 12           | 12 10         |
|           | 27  | .9460                          | 343          | —59    | 127    | .9794              | 54 15           | 13 26         |
|           |     |                                |              |        | Means  | 109.9381           |                 | 254 11 9      |
| 5<br>(52) | 7   | .7901                          | 533          | —53    | 114    | 110.8347           | 23 4 15         | 293 27 42     |
|           | 8   | .7909                          | 359          | —67    | 118    | .8256              | 4 20            | 31 8          |
|           | 9   | .7754                          | 386          | —67    | 118    | .8119              | 7 22            | 30 0          |
|           | 10  | .7926                          | 441          | —68    | 118    | .8482              | 8 16            | 30 55         |
|           | 16  | .8448                          | 387          | —71    | 116    | .8720              | 10 28           | 29 48         |
|           | 17  | .8508                          | 412          | —71    | 116    | .8760              | 10 44           | 29 56         |
|           | 19  | .8766                          | 546          | +72    | 118    | .9412              | 14 58           | 31 40         |
|           | 23  | .9017                          | 353          | —54    | 113    | .9313              | 10 35           | 31 20         |
|           | 24  | .8792                          | 379          | —54    | 113    | .9175              | 11 12           | 29 55         |

TABLE V.—RESULTS OF THE MEASURES. (*Continued.*)

| No.          | Pl. | Obs.<br>Dis-<br>tance<br>East. | Corrections. |        |        | Corrected<br>Mean. | Position Angle. |             |         |
|--------------|-----|--------------------------------|--------------|--------|--------|--------------------|-----------------|-------------|---------|
|              |     |                                | Refrac.      | Aberr. | Scale. |                    | E. Observed.    | Mean.       | Corr'd. |
| 5<br>(cont.) | 25  | .8893                          | 400          | —56    | 113    | 110.9386           | 23° 11' 44"     | 293° 31' 2" |         |
|              | 26  | .8852                          | 438          | —56    | 113    | .9254              | 11 20           | 30 15       |         |
|              | 27  | .8884                          | 376          | —59    | 117    | .9266              | 12 15           | 31 35       |         |
|              |     |                                |              |        | Means  | 110.8874           |                 | 293 30 26   |         |
| 6<br>(54)    | 7   | .3182                          | 529          | —51    | 112    | 105.3566           | 15 31 10        | 285 54 43   |         |
|              | 9   | .3179                          | 362          | —64    | 112    | .3561              | 33 52           | 56 39       |         |
|              |     |                                |              |        | Means  | 105.3564           |                 | 285 55 41   |         |
| 7<br>(25)    | 4   | .3442                          | 310          | +69    | 116    | 102.3946           | 350 8 7         | 260 28 52   |         |
|              | 7   | .3616                          | 539          | —49    | 122    | .4145              | 7 27            | 31 32       |         |
|              | 8   | .4031                          | 310          | —62    | 113    | .4253              | 7 56            | 35 2        |         |
|              | 9   | .3756                          | 332          | —62    | 118    | .4022              | 11 48           | 34 29       |         |
|              | 10  | .3703                          | 395          | —63    | 118    | .4062              | 12 4            | 35 8        |         |
|              | 15  | .4174                          | 413          | —66    | 106    | .4585              | 15 57           | 35 15       |         |
|              | 16  | .4268                          | 333          | —66    | 106    | .4597              | 15 4            | 34 18       |         |
|              | 17  | .4256                          | 356          | —66    | 106    | .4576              | 15 48           | 34 53       |         |
|              | 23  | .4932                          | 306          | —50    | 170    | .5348              | 17 10           | 37 32       |         |
|              | 24  | .4791                          | 327          | —50    | 116    | .5203              | 16 28           | 35 32       |         |
|              | 25  | .4984                          | 347          | —52    | 116    | .5328              | 17 55           | 37 4        |         |
|              | 26  | .4730                          | 398          | —52    | 116    | .5120              | 16 44           | 35 51       |         |
|              | 27  | .4857                          | 323          | —55    | 120    | .5182              | 18 44           | 37 37       |         |
|              |     |                                |              |        | Means  | 102.4644           |                 | 260 34 51   |         |
| 8<br>(66)    | 7   | .7521                          | 542          | —50    | 115    | 103.7926           | 345 34 50       | 255 58 44   |         |
|              | 8   | .7914                          | 315          | —63    | 113    | .8104              | 34 35           | 256 1 34    |         |
|              | 9   | .7648                          | 334          | —63    | 113    | .7976              | 37 46           | 0 36        |         |
|              | 10  | .7516                          | 394          | —64    | 112    | .8033              | 38 5            | 1 13        |         |
|              | 15  | .7668                          | 409          | —67    | 113    | .8320              | 42 57           | 1 33        |         |
|              | 16  | .8307                          | 333          | —67    | 112    | .8493              | 41 52           | 1 13        |         |
|              | 17  | .8254                          | 356          | —67    | 112    | .8478              | 42 8            | 1 14        |         |
|              | 23  | .8912                          | 308          | —50    | 112    | .9192              | 42 58           | 3 28        |         |
|              | 25  | .8670                          | 347          | —53    | 112    | .9065              | 44 17           | 3 46        |         |
|              | 27  | .8446                          | 325          | —55    | 114    | .8823              | 44 58           | 4 6         |         |
|              |     |                                |              |        | Means  | 103.8441           |                 | 256 1 45    |         |
| 9<br>(55)    | 7   | .6878                          | 516          | —49    | 121    | 101.7220           | 13 25 4         | 283 48 32   |         |
|              | 8   | .6954                          | 327          | —62    | 120    | .7275              | 23 15           | 50 37       |         |
|              |     |                                |              |        | Means  | 101.7248           |                 | 283 49 34   |         |
| 10<br>(24)   | 1   | .3710                          | 456          | +84    | 48     | 125.4211           | 321 7 36        | 231 28 37   |         |
|              | 7   | .3553                          | 568          | —60    | 48     | .3876              | 4 25            | 28 27       |         |
|              | 8   | .3794                          | 370          | —76    | 50     | .4021              | 4 47            | 31 55       |         |
|              | 9   | .3792                          | 377          | —76    | 50     | .4009              | 8 55            | 31 34       |         |
|              | 10  | .3697                          | 418          | —78    | 50     | .3959              | 8 38            | 31 51       |         |
|              | 15  | .3773                          | 435          | —80    | 42     | .4143              | 13 49           | 33 1        |         |
|              | 16  | .4216                          | 381          | —81    | 42     | .4344              | 12 16           | 31 54       |         |
|              | 17  | .3995                          | 394          | —81    | 42     | .4261              | 13 35           | 32 58       |         |
|              | 23  | .4602                          | 365          | —61    | 48     | .4826              | 14 15           | 34 47       |         |
|              | 25  | .4608                          | 379          | —64    | 42     | .4901              | 15 47           | 35 21       |         |



TABLE V.—RESULTS OF THE MEASURES. (*Continued.*)

| No.                           | Pl. | Obs.<br>Dis-<br>tance<br>East. | Corrections. |        |        | Corrected<br>Mean. | Position Angle. |              |         |
|-------------------------------|-----|--------------------------------|--------------|--------|--------|--------------------|-----------------|--------------|---------|
|                               |     |                                | Refrac.      | Aberr. | Scale. |                    | E. Observed.    | Mean.        | Corr'd. |
| <b>10</b><br>( <i>cont.</i> ) | 27  | .4489                          | 376          | —67    | 48     | 125.4853           | 321° 16' 38"    | 231° 35' 57" |         |
|                               |     |                                |              |        | Means  | 125.4309           |                 |              |         |
| <b>11</b><br>(68)             | 7   | .1254                          | 543          | —56    | 112    | 116.1829           | 324 41 14       | 235          | 5 9     |
|                               | 8   | .1509                          | 343          | —70    | 115    | .1828              |                 |              | 8 3     |
|                               | 9   | .1740                          | 352          | —70    | 115    | .1819              |                 |              | 7 15    |
|                               | 10  | .1596                          | 396          | —72    | 117    | .1797              |                 |              | 7 51    |
|                               | 27  | .2204                          | 350          | —62    | 122    | .2505              |                 |              | 11 0    |
|                               |     |                                |              |        | Means  | 116.1956           |                 | 235          | 7 52    |
| <b>12</b><br>(47)             | 7   | .9796                          | 519          | —64    | 16     | 134.0055           | 46 54 13        | 317          | 18 2    |
|                               |     |                                |              |        |        |                    |                 |              |         |
| <b>13</b><br>(62)             | 7   | .6570                          | 481          | —44    | 132    | 90.7067            | 358 25 2        | 268          | 48 25   |
|                               | 8   | .6588                          | 280          | —55    | 134    | .7066              |                 |              | 52 33   |
|                               | 9   | .6555                          | 301          | —55    | 134    | .6857              |                 |              | 51 7    |
|                               | 15  | .6820                          | 375          | —58    | 128    | .7283              |                 |              | 52 7    |
|                               | 16  | .7198                          | 302          | —58    | 130    | .7351              |                 |              | 52 7    |
|                               | 23  | .7746                          | 276          | —44    | 134    | .8018              |                 |              | 53 36   |
|                               | 25  | .7842                          | 317          | —46    | 134    | .8278              |                 |              | 53 17   |
|                               |     |                                |              |        | Means  | 90.7417            |                 | 268          | 51 53   |
| <b>14</b><br>(19)             | 7   | .2492                          | 550          | —64    | 17     | 132.2783           | 312 15 45       | 222          | 39 54   |
|                               | 8   | .3072                          | 392          | —80    | 18     | .3163              |                 |              | 43 48   |
|                               | 9   | .3120                          | 394          | —80    | 18     | .3192              |                 |              | 43 41   |
|                               | 10  | .2980                          | 419          | —82    | 17     | .3102              |                 |              | 43 16   |
|                               | 16  | .3082                          | 398          | —85    | 18     | .3423              |                 |              | 44 9    |
|                               | 23  | .3940                          | 386          | —64    | 17     | .4186              |                 |              | 47 40   |
|                               |     |                                |              |        | Means  | 132.3308           |                 | 222          | 43 45   |
| <b>15</b><br>(53)             | 7   | .8594                          | 449          | —45    | 136    | 92.9037            | 21 31 16        | 291          | 55 12   |
|                               | 8   | .8820                          | 303          | —56    | 134    | .9142              |                 |              | 57 46   |
|                               |     |                                |              |        | Means  | 92.9090            |                 | 291          | 56 29   |
| <b>16</b><br>(50)             | 7   | .2709                          | 419          | —45    | 134    | 93.3088            | 31 37 36        | 302          | 1 14    |
|                               | 8   | .2566                          | 307          | —56    | 132    | .2951              |                 |              | 4 12    |
|                               | 9   | .2763                          | 326          | —56    | 132    | .3056              |                 |              | 2 23    |
|                               | 17  | .3133                          | 346          | —60    | 132    | .3488              |                 |              | 2 36    |
|                               |     |                                |              |        | Means  | 93.3146            |                 | 302          | 2 36    |
| <b>17</b><br>(26)             | 1   | .0344                          | 289          | —49    | 122    | 73.0966            | 350 26 22       | 260          | 46 48   |
|                               | 7   | .0406                          | 384          | —35    | 122    | .0989              |                 |              | 47 44   |
|                               | 8   | .0923                          | 222          | —44    | 118    | .1204              |                 |              | 50 48   |
|                               | 9   | .0906                          | 238          | —44    | 118    | .1126              |                 |              | 50 7    |
|                               | 10  | .0813                          | 283          | —45    | 117    | .1175              |                 |              | 50 36   |
|                               | 11  | .1078                          | 334          | +43    | 118    | .1617              |                 |              | 51 14   |
|                               | 12  | .1402                          | 302          | +43    | 118    | .1751              |                 |              | 51 5    |
|                               | 15  | .1080                          | 295          | —48    | 116    | .1491              |                 |              | 51 40   |
|                               | 16  | .1378                          | 238          | —47    | 120    | .1599              |                 |              | 50 27   |
|                               | 17  | .1355                          | 255          | —47    | 116    | .1637              |                 |              | 50 15   |
|                               | 18  | .1522                          | 398          | —48    | 118    | .2196              |                 |              | 52 21   |

TABLE V.—RESULTS OF THE MEASURES. (*Continued.*)

| No.                           | Pl. | Obs.<br>Dis-<br>tance<br>East. | Corrections. |        |        | Corrected<br>Mean. | Position Angle. |               |  |
|-------------------------------|-----|--------------------------------|--------------|--------|--------|--------------------|-----------------|---------------|--|
|                               |     |                                | Refrac.      | Aberr. | Scale. |                    | E. Observed.    | Mean, Corr'd. |  |
| <b>17</b><br>( <i>cont.</i> ) | 21  | .1310                          | 393          | +49    | 120    | 73.1852            | 350° 35' 38"    | 260° 54' 38"  |  |
|                               | 23  | .2014                          | 219          | —36    | 118    | .2169              | 32 12           | 52 45         |  |
|                               | 24  | .1873                          | 234          | —36    | 124    | .2144              | 32 16           | 51 3          |  |
|                               | 25  | .1896                          | 247          | —37    | 122    | .2192              | 34 14           | 53 16         |  |
|                               | 26  | .1758                          | 285          | —37    | 124    | .1508              | 33 54           | 52 7          |  |
|                               | 27  | .1802                          | 231          | —39    | 122    | .2103              | 34 47           | 53 28         |  |
|                               |     |                                |              |        | Means  | 73.1631            |                 | 260 51 12     |  |
| <b>18</b><br>(70)             | 7   | .4454                          | 358          | —34    | 121    | 70.4838            | 338° 53' 24"    | 249° 16' 34"  |  |
|                               | 8   | .4712                          | 212          | —43    | 121    | .4993              | 52 58           | 19 29         |  |
|                               |     |                                |              |        | Means  | 70.4916            |                 | 249 18 2      |  |
| <b>19</b><br>(3)              | 1   | .0580                          | 267          | +47    | 128    | 70.1077            | 330° 4' 6"      | 240° 25' 5"   |  |
|                               | 2   | .0700                          | 248          | +47    | 128    | .1077              | 7 33            | 26 27         |  |
|                               | 3   | .0774                          | 204          | +47    | 122    | .1115              | 6 8             | 26 38         |  |
|                               | 4   | .0647                          | 220          | +47    | 128    | .1025              | 0 54            | 21 35         |  |
|                               | 5   | .1102                          | 305          | +46    | 124    | .1518              | 4 42            | 27 37         |  |
|                               | 6   | .1109                          | 281          | +46    | 122    | .1518              | 329 59 52       | 27 38         |  |
|                               | 7   | .0726                          | 339          | —34    | 124    | .1126              | 330° 0' 50"     | 24 59         |  |
|                               | 8   | .0876                          | 208          | —42    | 121    | .1159              | 2 26            | 29 46         |  |
|                               | 9   | .0998                          | 215          | —42    | 121    | .1217              | 5 32            | 28 13         |  |
|                               | 10  | .0778                          | 246          | —43    | 121    | .1058              | 6 2             | 29 28         |  |
|                               | 11  | .1077                          | 284          | +42    | 121    | .1526              | 10 7            | 31 22         |  |
|                               | 12  | .1453                          | 272          | +42    | 125    | .1878              | 7 58            | 30 48         |  |
|                               | 13  | .1475                          | 320          | +47    | 122    | .1850              | 13 8            | 31 13         |  |
|                               | 14  | .1367                          | 306          | +47    | 121    | .1747              | 10 26           | 31 28         |  |
|                               | 15  | .1022                          | 257          | —45    | 114    | .1319              | 10 40           | 30 8          |  |
|                               | 16  | .1166                          | 216          | —45    | 120    | .1372              | 10 40           | 29 45         |  |
|                               | 17  | .1118                          | 227          | —45    | 122    | .1391              | 10 50           | 30 23         |  |
|                               | 18  | .1546                          | 308          | +46    | 121    | .2008              | 14 15           | 31 46         |  |
|                               | 19  | .1668                          | 297          | +46    | 121    | .2046              | 16 20           | 33 59         |  |
|                               | 20  | .1500                          | 325          | +47    | 121    | .1869              | 14 8            | 33 34         |  |
|                               | 21  | .1372                          | 311          | +47    | 126    | .1861              | 15 46           | 35 32         |  |
|                               | 22  | .1434                          | 325          | +47    | 122    | .1946              | 14 36           | 33 53         |  |
|                               | 23  | .1720                          | 205          | —34    | 128    | .1957              | 12 25           | 32 54         |  |
|                               | 24  | .1674                          | 212          | —34    | 128    | .1972              | 12 35           | 31 30         |  |
|                               | 25  | .1588                          | 220          | —36    | 128    | .1886              | 14 0            | 33 6          |  |
|                               | 26  | .1517                          | 248          | —36    | 128    | .1865              | 12 38           | 31 20         |  |
|                               | 27  | .1578                          | 213          | —37    | 128    | .1901              | 13 33           | 33 7          |  |
|                               |     |                                |              |        | Means  | 70.1566            |                 | 240 30 17     |  |
| <b>20</b><br>(69)             | 7   | .1887                          | 329          | —31    | 102    | 65.2231            | 337° 26' 12"    | 247° 50' 20"  |  |
|                               | 8   | .2010                          | 196          | —39    | 102    | .2253              | 25 55           | 53 19         |  |
|                               |     |                                |              |        | Means  | 65.2242            |                 | 247 51 50     |  |
| <b>21</b><br>(27)             | 1   | .5772                          | 302          | +68    | 126    | 100.6260           | 54° 59' 34"     | 325° 19' 37"  |  |
|                               | 4   | .5922                          | 273          | —68    | 126    | .6404              | 56 8            | 17 9          |  |
|                               | 7   | .6514                          | 362          | —48    | 126    | .6769              | 53 32           | 16 55         |  |
|                               | 8   | .6430                          | 333          | —61    | 126    | .6787              | 54 2            | 20 47         |  |
|                               | 9   | .6456                          | 345          | —61    | 126    | .6764              | 57 38           | 20 17         |  |

TABLE V.—RESULTS OF THE MEASURES. (*Continued.*)

| No.                           | Pl. | Obs.<br>Dis-<br>tance<br>East. | Corrections. |        |        | Corrected<br>Mean. | Position Angle. |               |  |
|-------------------------------|-----|--------------------------------|--------------|--------|--------|--------------------|-----------------|---------------|--|
|                               |     |                                | Refrac.      | Aberr. | Scale. |                    | E. Observed.    | Mean, Corr'd. |  |
| <b>21</b><br>( <i>cont.</i> ) | 10  | .6574                          | 351          | —63    | 126    | 100.6911           | 54° 58' 8"      | 325° 20' 57"  |  |
|                               | 11  | .6470                          | 345          | —60    | 126    | .6983              | 58 38           | 19 20         |  |
|                               | 12  | .6690                          | 308          | —60    | 126    | .7118              | 56 40           | 19 17         |  |
|                               | 13  | .6744                          | 504          | —67    | 124    | .7381              | 55 3 14         | 19 39         |  |
|                               | 14  | .6916                          | 405          | —67    | 123    | .7303              | 54 59 16        | 19 50         |  |
|                               | 15  | .6785                          | 362          | —65    | 121    | .7066              | 55 1 5          | 19 57         |  |
|                               | 16  | .6796                          | 347          | —65    | 121    | .7126              | 54 59 42        | 18 42         |  |
|                               | 17  | .6682                          | 357          | —65    | 121    | .7003              | 59 35           | 18 45         |  |
|                               | 18  | .6978                          | 449          | —66    | 126    | .7580              | 55 2 2          | 18 14         |  |
|                               | 20  | .6983                          | 546          | —67    | 123    | .7497              | 0 55            | 19 17         |  |
|                               | 23  | .7101                          | 328          | —49    | 126    | .7507              | 54 58 48        | 19 1          |  |
|                               | 24  | .7122                          | 340          | —49    | 126    | .7428              | 59 4            | 18 8          |  |
|                               | 25  | .7163                          | 344          | —51    | 126    | .7503              | 59 50           | 19 5          |  |
|                               | 26  | .7176                          | 350          | —51    | 126    | .7518              | 59 45           | 18 24         |  |
|                               | 27  | .7234                          | 343          | —54    | 128    | .7438              | 55 0 56         | 19 48         |  |
|                               |     |                                |              |        | Means  | 100.7117           |                 | 325 19 9      |  |
| <b>22</b><br>(56)             | 7   | .7576                          | 305          | —32    | 108    | 66.7887            | 30 1 18         | 300 25 13     |  |
|                               | 8   | .7700                          | 219          | —40    | 111    | .7955              | 0 27            | 27 28         |  |
|                               | 9   | .7520                          | 233          | —40    | 105    | .7845              | 4 54            | 27 32         |  |
|                               |     |                                |              |        | Means  | 66.7896            |                 | 300 26 44     |  |
| <b>23</b><br>(5)              | 1   | .3805                          | 216          | —41    | 104    | 60.4152            | 25 21 15        | 295 41 38     |  |
|                               | 3   | .3808                          | 162          | —41    | 97     | .4107              | 22 44           | 43 18         |  |
|                               | 4   | .3853                          | 168          | —41    | 104    | .4162              | 18 10           | 39 11         |  |
|                               | 5   | .4130                          | 325          | —40    | 106    | .4634              | 19 54           | 42 18         |  |
|                               | 6   | .4188                          | 248          | —40    | 104    | .4581              | 14 52           | 42 4          |  |
|                               | 7   | .4166                          | 285          | —29    | 102    | .4439              | 18 55           | 42 31         |  |
|                               | 8   | .4165                          | 198          | —37    | 102    | .4526              | 17 54           | 45 0          |  |
|                               | 9   | .4380                          | 210          | —37    | 102    | .4533              | 19 25           | 43 23         |  |
|                               | 10  | .4267                          | 239          | —37    | 102    | .4589              | 21 44           | 44 40         |  |
|                               | 11  | .4628                          | 264          | —36    | 102    | .5068              | 22 44           | 43 36         |  |
|                               | 12  | .4777                          | 230          | —36    | 102    | .5125              | 20 6            | 42 33         |  |
|                               | 13  | .4764                          | 391          | —40    | 104    | .5325              | 27 32           | 44 16         |  |
|                               | 14  | .4729                          | 316          | —40    | 104    | .5201              | 23 24           | 44 14         |  |
|                               | 15  | .4660                          | 249          | —39    | 98     | .4950              | 24 22           | 43 38         |  |
|                               | 16  | .4792                          | 212          | —39    | 102    | .5038              | 23 40           | 42 41         |  |
|                               | 17  | .4796                          | 225          | —39    | 102    | .5023              | 23 53           | 43 6          |  |
|                               | 18  | .5033                          | 348          | —40    | 102    | .5626              | 25 48           | 43 17         |  |
|                               | 19  | .5227                          | 296          | —40    | 102    | .5641              | 27 30           | 44 25         |  |
|                               | 20  | .4982                          | 417          | —40    | 104    | .5472              | 26 22           | 44 45         |  |
|                               | 21  | .5014                          | 335          | —40    | 100    | .5401              | 28 14           | 46 47         |  |
|                               | 22  | .4890                          | 333          | —40    | 100    | .5475              | 25 48           | 44 39         |  |
|                               | 23  | .5384                          | 193          | —29    | 104    | .5591              | 22 48           | 43 15         |  |
|                               | 24  | .5270                          | 207          | —29    | 104    | .5511              | 22 52           | 42 16         |  |
|                               | 25  | .5296                          | 218          | —31    | 104    | .5577              | 24 25           | 43 48         |  |
|                               | 26  | .5280                          | 240          | —31    | 104    | .5548              | 24 14           | 42 44         |  |
|                               | 27  | .5148                          | 206          | —32    | 105    | .5498              | 24 50           | 43 48         |  |
|                               |     |                                |              |        | Means  | 60.5030            |                 | 295 43 23     |  |

TABLE V.—RESULTS OF THE MEASURES. (*Continued.*)

| No.        | Pl. | Obs.<br>Dis-<br>tance<br>East | Corrections. |        |        | Corrected<br>Mean. | Position Angle. |              |         |
|------------|-----|-------------------------------|--------------|--------|--------|--------------------|-----------------|--------------|---------|
|            |     |                               | Refrac.      | Aberr. | Scale. |                    | E. Observed.    | Mean.        | Corr'd. |
| 24<br>(36) | 7   | .4443                         | 236          | —27    | 100    | 55.4739            | 314° 20' 6"     | 224° 43' 26" |         |
|            | 8   | .4552                         | 165          | —34    | 96     | .4763              | 19 44           | 46 43        |         |
|            | 11  | .4711                         | 195          | —33    | 96     | .5028              | 26 53           | 49 7         |         |
|            | 12  | .5088                         | 194          | —33    | 101    | .5267              | 26 20           | 49 35        |         |
|            | 13  | .4736                         | 200          | —37    | 96     | .5079              | 31 14           | 48 24        |         |
|            | 14  | .4822                         | 200          | —37    | 96     | .5043              | 27 14           | 48 58        |         |
|            | 15  | .4446                         | 186          | —36    | 96     | .4774              | 29 40           | 48 44        |         |
|            | 16  | .4592                         | 167          | —36    | 98     | .4746              | 28 56           | 47 44        |         |
|            | 17  | .4640                         | 171          | —36    | 98     | .4937              | 28 54           | 48 12        |         |
|            | 23  | .5202                         | 162          | —27    | 100    | .5342              | 32 26           | 52 22        |         |
|            | 24  | .5163                         | 163          | —27    | 96     | .5322              | 30 56           | 50 10        |         |
|            | 25  | .5047                         | 165          | —28    | 100    | .5296              | 34 15           | 53 16        |         |
|            | 26  | .5170                         | 180          | —28    | 100    | .5355              | 32 12           | 51 1         |         |
|            | 27  | .5112                         | 166          | —30    | 102    | .5348              | 32 34           | 51 33        |         |
|            |     |                               |              |        | Means  | 55.5074            |                 | 224 49 14    |         |
| 25<br>(61) | 7   | .0398                         | 200          | —20    | 114    | 42.0643            | 24 49 17        | 295 12 39    |         |
|            | 8   | .0376                         | 137          | —25    | 114    | .0622              | 48 00           | 14 41        |         |
|            | 17  | .0948                         | 157          | —27    | 109    | .1129              | 53 26           | 13 22        |         |
|            | 23  | .1240                         | 134          | —20    | 114    | .1450              | 51 30           | 13 2         |         |
|            | 27  | .1029                         | 143          | —22    | 117    | .1459              | 56 18           | 14 21        |         |
|            |     |                               |              |        | Means  | 42.1061            |                 | 295 13 37    |         |
| 26<br>(2)  | 1   | .2534                         | 240          | —51    | 128    | 75.2881            | 300 24 8        | 210 45 19    |         |
|            | 2   | .2327                         | 239          | —51    | 131    | .2736              | 26 50           | 46 10        |         |
|            | 3   | .2516                         | 225          | —51    | 131    | .2855              | 25 44           | 46 26        |         |
|            | 4   | .2534                         | 231          | —51    | 131    | .2880              | 20 45           | 41 30        |         |
|            | 5   | .2644                         | 225          | —49    | 131    | .3017              | 24 46           | 47 17        |         |
|            | 6   | .2741                         | 236          | —49    | 132    | .3067              | 19 57           | 47 17        |         |
|            | 7   | .2307                         | 278          | —36    | 132    | .2629              | 20 36           | 44 45        |         |
|            | 8   | .2465                         | 228          | —46    | 132    | .2684              | 21 35           | 49 0         |         |
|            | 9   | .2460                         | 223          | —46    | 132    | .2661              | 24 53           | 47 34        |         |
|            | 10  | .2356                         | 226          | —47    | 132    | .2606              | 25 10           | 48 30        |         |
|            | 11  | .2472                         | 234          | —45    | 134    | .2868              | 30 55           | 51 39        |         |
|            | 12  | .2527                         | 236          | —45    | 132    | .2879              | 28 00           | 51 14        |         |
|            | 13  | .2780                         | 224          | —50    | 130    | .3041              | 34 24           | 51 28        |         |
|            | 14  | .2658                         | 233          | —50    | 134    | .3029              | 30 5            | 50 46        |         |
|            | 15  | .2260                         | 235          | —48    | 130    | .2592              | 31 37           | 50 19        |         |
|            | 16  | .2389                         | 226          | —48    | 130    | .2594              | 30 34           | 49 20        |         |
|            | 17  | .2277                         | 227          | —48    | 130    | .2559              | 31 20           | 50 10        |         |
|            | 18  | .2530                         | 225          | —49    | 132    | .2935              | 34 4            | 52 13        |         |
|            | 19  | .2652                         | 233          | —49    | 134    | .3060              | 36 22           | 53 49        |         |
|            | 20  | .2452                         | 221          | —50    | 134    | .2889              | 35 8            | 54 15        |         |
|            | 21  | .2718                         | 230          | —50    | 136    | .3019              | 36 10           | 55 15        |         |
|            | 22  | .2698                         | 226          | —50    | 131    | .3067              | 35 5            | 54 38        |         |
|            | 23  | .2630                         | 222          | —37    | 134    | .2862              | 33 25           | 53 33        |         |
|            | 24  | .2756                         | 220          | —37    | 134    | .3036              | 33 37           | 52 15        |         |
|            | 25  | .2821                         | 218          | —38    | 134    | .2998              | 34 48           | 54 5         |         |
|            | 26  | .2598                         | 226          | —38    | 131    | .2866              | 32 53           | 52 2         |         |
|            | 27  | .2662                         | 227          | —40    | 131    | .2940              | 34 35           | 53 32        |         |
|            |     |                               |              |        | Means  | 75.2861            |                 | 210 50 10    |         |

TABLE V.—RESULTS OF THE MEASURES. (*Continued.*)

| No.        | Pl. | Obs.<br>Dis-<br>tance<br>East | Corrections. |        |        | Corrected<br>Mean. | Position Angle. |              |
|------------|-----|-------------------------------|--------------|--------|--------|--------------------|-----------------|--------------|
|            |     |                               | Refrac       | Aberr. | Scale. |                    | E. Observed.    | Mean, Corr'd |
| 27<br>(46) | 7   | .6608                         | 318          | —49    | 126    | 100.6861           | 70° 15' 12"     | 340° 39' 22" |
|            | 8   | .6489                         | 332          | —61    | 126    | .6819              | 16 00           | 43 5         |
|            |     |                               |              |        | Means  | 100.6840           |                 | 340 41 14    |
| 28<br>(60) | 7   | .6276                         | 169          | —19    | 110    | 39.6272            | 37 57 28        | 308 20 52    |
| 29<br>(28) | 1   | .2960                         | 338          | —60    | 129    | 88.3437            | 72 26 44        | 342 47 16    |
|            | 7   | .3690                         | 275          | —42    | 128    | .3925              | 20 4            | 43 55        |
|            | 8   | .3493                         | 291          | —53    | 124    | .3806              | 21 40           | 48 28        |
|            | 9   | .3647                         | 293          | —53    | 124    | .3960              | 23 34           | 46 37        |
|            | 10  | .3541                         | 280          | —55    | 124    | .3913              | 25 48           | 48 19        |
|            | 11  | .3354                         | 259          | —52    | 124    | .3853              | 24 40           | 45 16        |
|            | 12  | .3578                         | 244          | —52    | 124    | .3949              | 22 35           | 45 27        |
|            | 17  | .3858                         | 295          | —57    | 122    | .4162              | 25 42           | 45 2         |
|            | 23  | .4084                         | 286          | —43    | 129    | .4248              | 24 28           | 45 25        |
|            | 25  | .3914                         | 282          | —45    | 129    | .4227              | 25 54           | 45 16        |
|            | 27  | .3941                         | 293          | —47    | 130    | .4290              | 27 10           | 45 54        |
|            |     |                               |              |        | Means  | 88.3979            |                 | 342 46 5     |
| 30<br>(59) | 7   | .9032                         | 113          | —14    | —13    | 29.8995            | 50 28 7         | 320 51 22    |
| 31<br>(14) | 1   | .7500                         | 126          | —27    | 112    | 40.7834            | 293 8 58        | 203 31 14    |
|            | 2   | .7624                         | 126          | —28    | 116    | .7903              | 14 36           | 33 32        |
|            | 3   | .7477                         | 122          | —27    | 116    | .7743              | 11 8            | 31 57        |
|            | 4   | .7442                         | 124          | —27    | 116    | .7694              | 7 55            | 28 47        |
|            | 5   | .7609                         | 115          | —27    | 116    | .7816              | 14 13           | 35 53        |
|            | 6   | .7589                         | 122          | —27    | 116    | .7841              | 8 8             | 35 43        |
|            | 7   | .7037                         | 141          | —20    | 116    | .7327              | 9 40            | 33 46        |
|            | 8   | .7353                         | 124          | —25    | 116    | .7583              | 9 35            | 37 28        |
|            | 9   | .7476                         | 122          | —25    | 116    | .7650              | 14 42           | 37 15        |
|            | 10  | .7319                         | 119          | —25    | 116    | .7492              | 12 44           | 36 58        |
|            | 11  | .7584                         | 118          | —24    | 116    | .7742              | 21 5            | 42 35        |
|            | 12  | .7443                         | 121          | —24    | 116    | .7731              | 20 5            | 42 39        |
|            | 13  | .7525                         | 113          | —27    | 116    | .7780              | 24 25           | 42 19        |
|            | 14  | .7455                         | 117          | —27    | 116    | .7650              | 21 20           | 42 49        |
|            | 15  | .7176                         | 123          | —26    | 112    | .7411              | 22 50           | 41 48        |
|            | 16  | .7306                         | 123          | —26    | 112    | .7469              | 20 56           | 40 0         |
|            | 17  | .7286                         | 123          | —26    | 112    | .7482              | 22 28           | 40 47        |
|            | 18  | .7440                         | 113          | +27    | 116    | .7796              | 27 16           | 45 2         |
|            | 19  | .7474                         | 117          | —27    | 116    | .7734              | 28 10           | 46 14        |
|            | 20  | .7566                         | 113          | —27    | 116    | .7824              | 26 16           | 45 2         |
|            | 21  | .7655                         | 115          | —27    | 116    | .7776              | 28 46           | 47 38        |
|            | 22  | .7633                         | 114          | +27    | 116    | .7828              | 27 17           | 46 16        |
|            | 23  | .7601                         | 122          | —20    | 116    | .7802              | 24 49           | 45 22        |
|            | 24  | .7610                         | 120          | —20    | 116    | .7862              | 25 38           | 44 22        |
|            | 25  | .7514                         | 117          | —21    | 116    | .7737              | 27 57           | 46 55        |
|            | 26  | .7580                         | 119          | —21    | 116    | .7818              | 25 18           | 44 47        |
|            | 27  | .7570                         | 124          | —22    | 116    | .7778              | 27 0            | 46 13        |
|            |     |                               |              |        | Means  | 40.7707            |                 | 203 40 30    |

TABLE V.—RESULTS OF THE MEASURES. (*Continued.*)

| No.        | Pl. | Obs.<br>Dis-<br>tance<br>East. | Corrections. |        |        | Corrected<br>Mean. | Position Angle. |               |  |
|------------|-----|--------------------------------|--------------|--------|--------|--------------------|-----------------|---------------|--|
|            |     |                                | Refrac.      | Aberr. | Scale. |                    | E. Observed.    | Mean, Corr'd. |  |
| 32<br>(57) | 7   | .7052                          | 137          | —21    | 118    | 42.7267            | 67° 44' 7"      | 338° 8' 7"    |  |
|            | 8   | .6935                          | 540          | —26    | 118    | .7177              | 43 55           | 10 45         |  |
|            | 17  | .7254                          | 144          | —27    | 118    | .7437              | 47 56           | 6 42          |  |
|            | 25  | .7296                          | 138          | —22    | 118    | .7569              | 45 28           | 4 24          |  |
|            |     |                                |              |        | Means  | 42.7362            |                 | 338 7 30      |  |
| 33<br>(8)  | 1   | .8902                          | 41           | —7     | 44     | 10.9237            | 324 42 12       | 235 2 48      |  |
|            | 2   | .8972                          | 38           | —7     | 40     | .9050              | 49 32           | 7 56          |  |
|            | 3   | .8938                          | 32           | —7     | 44     | .9010              | 39 13           | 0 20          |  |
|            | 5   | .9316                          | 45           | —7     | 43     | .9331              | 54 25           | 17 20         |  |
|            | 6   | .9358                          | 43           | —7     | 44     | .9394              | 49 6            | 17 7          |  |
|            | 7   | .8984                          | 51           | —5     | 44     | .9073              | 52 50           | 15 8          |  |
|            | 8   | .9037                          | 32           | —7     | 40     | .9127              | 56 38           | 24 33         |  |
|            | 10  | .8982                          | 37           | —7     | 42     | .9073              | 59 38           | 23 50         |  |
|            | 11  | .9554                          | 43           | —7     | 40     | .9677              | 325 3 26        | 29 8          |  |
|            | 12  | .9818                          | 41           | —7     | 44     | .9837              | 10 45           | 32 14         |  |
|            | 13  | .9508                          | 46           | —7     | 40     | .9623              | 16 12           | 32 47         |  |
|            | 14  | .9428                          | 45           | —7     | 40     | .9598              | 16 42           | 37 24         |  |
|            | 15  | .8973                          | 39           | —7     | 39     | .9169              | 22 13           | 37 54         |  |
|            | 16  | .9206                          | 33           | —7     | 44     | .9333              | 16 55           | 35 0          |  |
|            | 17  | .9386                          | 35           | —7     | 44     | .9395              | 16 46           | 35 51         |  |
|            | 18  | .9682                          | 45           | —7     | 43     | .9827              | 24 42           | 43 44         |  |
|            | 19  | .9952                          | 45           | —7     | 40     | .9962              | 34 57           | 51 28         |  |
|            | 21  | .9554                          | 46           | —7     | 40     | .9618              | 22 14           | 40 36         |  |
|            | 22  | .9702                          | 48           | —7     | 37     | .9840              | 32 20           | 53 46         |  |
|            | 23  | .9872                          | 32           | —5     | 40     | .9913              | 27 0            | 46 21         |  |
|            | 24  | .9924                          | 33           | —5     | 40     | .9945              | 21 25           | 41 1          |  |
|            | 25  | .9967                          | 34           | —6     | 40     | .9984              | 23 52           | 43 23         |  |
|            | 26  | .9902                          | 38           | —6     | 40     | .9892              | 26 32           | 43 57         |  |
|            | 27  | .9715                          | 33           | —6     | 43     | .9796              | 24 17           | 43 34         |  |
|            |     |                                |              |        | Means  | 10.9529            |                 | 235 31 33     |  |
| 34<br>(63) | 7   | .1168                          | 251          | —40    | 126    | 84.1374            | 84 31 6         | 354 54 41     |  |
| 35<br>(65) | 7   | .1004                          | 147          | —24    | 108    | 49.1200            | 83 19 12        | 353 43 19     |  |
| 36<br>(29) | 1   | .2456                          | 368          | +63    | 141    | 93.2954            | 87 41 2         | 358 1 12      |  |
|            | 2   | .2324                          | 259          | +63    | 132    | .2742              | 42 46           | 1 57          |  |
|            | 4   | .2404                          | 265          | +63    | 132    | .2842              | 37 7            | 357 57 45     |  |
|            | 7   | .3016                          | 278          | —45    | 132    | .3314              | 33 57           | 57 29         |  |
|            | 8   | .2834                          | 300          | —56    | 136    | .3138              | 34 12           | 358 1 25      |  |
|            | 9   | .2880                          | 295          | —56    | 137    | .3154              | 37 10           | 357 59 55     |  |
|            | 10  | .2808                          | 276          | —58    | 137    | .3127              | 38 15           | 358 0 55      |  |
|            | 11  | .2680                          | 251          | +55    | 136    | .3108              | 37 24           | 357 58 33     |  |
|            | 12  | .2726                          | 250          | +55    | 136    | .3118              | 35 32           | 58 25         |  |
|            | 13  | .2743                          | 287          | +62    | 136    | .3147              | 42 38           | 58 53         |  |
|            | 14  | .2576                          | 261          | +62    | 136    | .3159              | 39 25           | 358 0 15      |  |
|            | 15  | .3110                          | 284          | —60    | 136    | .3329              | 39 48           | 357 59 4      |  |
|            | 16  | .2972                          | 298          | —60    | 137    | .3255              | 38 44           | 58 2          |  |
|            | 17  | .2994                          | 294          | —60    | 137    | .3295              | 38 24           | 57 50         |  |

TABLE V.—RESULTS OF THE MEASURES. (*Continued.*)

| No.        | Pl. | Obs.<br>Dis-<br>tance<br>East. | Corrections. |        |        | Corrected<br>Mean. | Position Angle. |                   |
|------------|-----|--------------------------------|--------------|--------|--------|--------------------|-----------------|-------------------|
|            |     |                                | Refrac.      | Aberr. | Scale. |                    | E. Observed.    | Mean, Corr'd      |
| <b>36</b>  | 18  | .3012                          | 272          | +61    | 137    | 93.3464            | 87° 40' 6"      | 357° 56' 55"      |
| (cont.)    | 20  | .2948                          | 299          | +62    | 136    | .3451              | 39 58           | 58 12             |
|            | 21  | .2763                          | 267          | -62    | 134    | .3273              | 42 42           | 358 1 18          |
|            | 22  | .2919                          | 290          | +62    | 136    | .3420              | 40 38           | 357 58 16         |
|            | 23  | .3070                          | 292          | -45    | 137    | .3388              | 37 6            | 57 46             |
|            | 24  | .3055                          | 289          | -45    | 137    | .3346              | 37 56           | 56 51             |
|            | 25  | .2954                          | 280          | -47    | 137    | .3289              | 38 48           | 57 56             |
|            | 26  | .3006                          | 273          | -47    | 137    | .3329              | 37 55           | 56 57             |
|            | 27  | .2916                          | 299          | -50    | 132    | .3292              | 39 46           | 58 48             |
|            |     |                                |              |        | Means  | 93.3215            |                 | 357 58 54         |
| <b>37</b>  |     |                                |              |        |        |                    |                 |                   |
| ( $\eta$ ) |     |                                |              |        |        |                    |                 | $\eta$ Cassiopeiæ |
| <b>38</b>  | 8   | .6946                          | 147          | -28    | 115    | 45.7116            | 267 37 44       | 178 4 53          |
| (37)       |     |                                |              |        |        |                    |                 |                   |
| <b>39</b>  | 7   | .3196                          | 68           | -11    | 99     | 22.3294            | 96 33 44        | 6 59 40           |
| (35)       | 8   | .2984                          | 70           | -14    | 99     | .3159              | 31 48           | 58 59             |
|            | 23  | .3036                          | 69           | -11    | 98     | .3232              | 29 2            | 47 57             |
|            | 24  | .2844                          | 68           | -11    | 98     | .3043              | 24 49           | 43 41             |
|            | 25  | .3042                          | 66           | -11    | 98     | .3219              | 25 54           | 44 8              |
|            |     |                                |              |        | Means  | 22.3189            |                 | 6 50 53           |
| <b>40</b>  | 1   | .2014                          | 130          | -32    | 112    | 47.2221            | 93 5 4          | 3 25 16           |
| (7)        | 4   | .2002                          | 136          | -32    | 117    | .2298              | 92 59 55        | 21 2              |
|            | 5   | .2178                          | 128          | -31    | 117    | .2454              | 93 1 48         | 24 5              |
|            | 6   | .2004                          | 126          | -31    | 113    | .2314              | 92 53 52        | 22 1              |
|            | 7   | .2520                          | 141          | -23    | 113    | .2614              | 57 25           | 21 39             |
|            | 8   | .2270                          | 151          | -29    | 113    | .2515              | 57 44           | 24 5              |
|            | 10  | .2341                          | 138          | -29    | 114    | .2543              | 93 1 52         | 24 15             |
|            | 11  | .2067                          | 126          | -28    | 113    | .2310              | 92 58 25        | 19 34             |
|            | 12  | .2110                          | 128          | -28    | 113    | .2500              | 55 4            | 18 0              |
|            | 13  | .2434                          | 137          | -31    | 113    | .2708              | 93 1 50         | 18 59             |
|            | 14  | .2529                          | 130          | -31    | 113    | .2796              | 92 58 48        | 19 48             |
|            | 15  | .2550                          | 141          | -30    | 114    | .2722              | 93 1 35         | 20 55             |
|            | 16  | .2487                          | 149          | -30    | 114    | .2696              | 92 59 12        | 18 53             |
|            | 17  | .2424                          | 147          | -30    | 114    | .2647              | 59 45           | 18 49             |
|            | 18  | .2614                          | 131          | -31    | 113    | .2816              | 59 45           | 16 18             |
|            | 19  | .2649                          | 128          | +31    | 113    | .2833              | 93 0 5          | 17 6              |
|            | 20  | .2447                          | 143          | -32    | 113    | .2727              | 92 59 54        | 17 40             |
|            | 21  | .2355                          | 131          | -32    | 117    | .2721              | 93 2 58         | 20 46             |
|            | 22  | .2387                          | 139          | -32    | 117    | .2731              | 92 58 55        | 17 32             |
|            | 23  | .2424                          | 147          | -23    | 115    | .2662              | 56 12           | 17 4              |
|            | 24  | .2366                          | 145          | -23    | 115    | .2580              | 58 10           | 16 52             |
|            | 25  | .2370                          | 140          | -24    | 115    | .2648              | 56 55           | 16 40             |
|            | 26  | .2378                          | 136          | -24    | 115    | .2616              | 58 10           | 17 7              |
|            | 27  | .2436                          | 149          | -25    | 117    | .2660              | 59 13           | 17 46             |
|            |     |                                |              |        | Means  | 47.2597            |                 | 3 19 40           |

TABLE V.—RESULTS OF THE MEASURES. (*Continued.*)

| No.        | Pl. | Obs.<br>Dis-<br>tance<br>East. | Corrections. |        |        | Corrected<br>Mean. | Position Angle. |               |
|------------|-----|--------------------------------|--------------|--------|--------|--------------------|-----------------|---------------|
|            |     |                                | Refrac.      | Aberr. | Scale. |                    | E. Observed.    | Mean, Corr'd. |
| 41<br>(6)  | 1   | .4222                          | 211          | +52    | 134    | 76.4554            | 92° 35' 20"     | 2 55' 26"     |
|            | 2   | .4188                          | 215          | -52    | 135    | .4545              | 36 54           | 56 5          |
|            | 3   | .4172                          | 223          | -51    | 135    | .4576              | 35 35           | 56 32         |
|            | 4   | .4241                          | 220          | -51    | 135    | .4649              | 30 5            | 51 18         |
|            | 5   | .4446                          | 207          | -50    | 136    | .4792              | 32 34           | 54 52         |
|            | 6   | .4312                          | 204          | -50    | 135    | .4681              | 25 20           | 52 52         |
|            | 7   | .4584                          | 229          | -37    | 135    | .4815              | 27 40           | 51 41         |
|            | 8   | .4498                          | 245          | -46    | 135    | .4787              | 28 18           | 54 55         |
|            | 9   | .4465                          | 238          | -46    | 136    | .4757              | 31 55           | 54 21         |
|            | 10  | .4546                          | 223          | -47    | 136    | .4860              | 31 57           | 54 44         |
|            | 11  | .4441                          | 203          | -45    | 135    | .4799              | 31 32           | 52 10         |
|            | 12  | .4296                          | 206          | -45    | 134    | .4654              | 28 25           | 51 3          |
|            | 13  | .4602                          | 222          | -51    | 136    | .4998              | 35 0            | 52 15         |
|            | 14  | .4574                          | 210          | -51    | 135    | .4999              | 31 50           | 52 34         |
|            | 15  | .4574                          | 228          | -49    | 136    | .4876              | 32 44           | 51 55         |
|            | 16  | .4665                          | 241          | -49    | 136    | .4943              | 32 30           | 51 45         |
|            | 17  | .4592                          | 238          | -49    | 136    | .4911              | 31 52           | 51 23         |
|            | 18  | .4790                          | 212          | -50    | 135    | .5119              | 33 58           | 49 59         |
|            | 19  | .4828                          | 207          | 50     | 135    | .5191              | 32 50           | 50 38         |
|            | 20  | .4713                          | 231          | -51    | 135    | .5124              | 33 55           | 51 35         |
|            | 21  | .4512                          | 184          | -51    | 135    | .4951              | 35 53           | 54 48         |
|            | 22  | .4626                          | 225          | 51     | 135    | .5064              | 33 32           | 51 30         |
|            | 23  | .4722                          | 238          | -37    | 135    | .4976              | 30 00           | 50 32         |
|            | 24  | .4693                          | 234          | -37    | 135    | .4951              | 31 12           | 50 1          |
|            | 25  | .4516                          | 226          | -39    | 135    | .4874              | 31 34           | 50 57         |
|            | 26  | .4692                          | 221          | -39    | 135    | .4991              | 30 26           | 49 35         |
|            | 27  | .4621                          | 243          | -41    | 135    | .4930              | 32 32           | 51 36         |
|            |     |                                |              |        | Means  | 76.4865            |                 | 2 52 29       |
| 42<br>(45) | 7   | .5825                          | 354          | -57    | 118    | 117.5976           | 91° 30' 23"     | 1 54' 20"     |
|            | 9   | .5582                          | 367          | -71    | 119    | .5927              | 34 5            | 56 50         |
|            |     |                                |              |        | Means  | 117.5952           |                 | 1 55 35       |
| 43<br>(11) | 1   | .6092                          | 180          | +44    | 104    | 65.6412            | 264° 5' 16"     | 174° 26' 33"  |
|            | 3   | .6057                          | 190          | +44    | 104    | .6376              | 6 54            | 27 35         |
|            | 4   | .6130                          | 186          | +44    | 104    | .6408              | 3 20            | 24 1          |
|            | 5   | .6043                          | 194          | -43    | 104    | .6305              | 7 28            | 29 32         |
|            | 6   | .6016                          | 179          | -43    | 104    | .6326              | 1 35            | 29 11         |
|            | 7   | .5218                          | 195          | -32    | 104    | .5597              | 0 36            | 24 55         |
|            | 8   | .5589                          | 213          | -40    | 105    | .5825              | 3 37            | 30 34         |
|            | 9   | .5580                          | 210          | -40    | 105    | .5847              | 5 54            | 28 53         |
|            | 11  | .5440                          | 177          | +39    | 104    | .5711              | 11 36           | 33 11         |
|            | 12  | .5334                          | 176          | -39    | 106    | .5688              | 10 12           | 33 3          |
|            | 13  | .5603                          | 213          | -44    | 105    | .5938              | 16 40           | 32 58         |
|            | 14  | .5433                          | 190          | -44    | 106    | .5685              | 13 46           | 33 24         |
|            | 15  | .5220                          | 202          | -42    | 105    | .5517              | 11 34           | 30 46         |
|            | 16  | .5204                          | 212          | -42    | 105    | .5497              | 12 14           | 31 3          |
|            | 18  | .5168                          | 197          | +43    | 105    | .5484              | 17 10           | 34 11         |
|            | 19  | .5284                          | 184          | -43    | 105    | .5562              | 18 36           | 35 26         |
|            | 22  | .5330                          | 216          | -44    | 103    | .5557              | 17 23           | 35 54         |



TABLE V.—RESULTS OF THE MEASURES. (*Continued.*)

| No.                    | Pl. | Obs.<br>Dis-<br>tance<br>East. | Corrections. |        |        | Corrected<br>Mean. | Position Angle. |               |  |
|------------------------|-----|--------------------------------|--------------|--------|--------|--------------------|-----------------|---------------|--|
|                        |     |                                | Refrac.      | Aberr. | Scale. |                    | E. Observed.    | Mean, Corr'd. |  |
| 43<br>( <i>cont.</i> ) | 23  | .5340                          | 207          | —32    | 104    | 65.5599            | 264° 16' 4"     | 174° 36' 4"   |  |
|                        | 24  | .5347                          | 206          | —32    | 104    | .5594              | 15 25           | 34 21         |  |
|                        | 25  | .5284                          | 198          | —33    | 104    | .5492              | 17 5            | 35 50         |  |
|                        | 26  | .5242                          | 195          | —33    | 104    | .5435              | 15 50           | 34 48         |  |
|                        | 27  | .5228                          | 212          | —35    | 104    | .5445              | 16 18           | 35 40         |  |
|                        |     |                                |              |        | Means  | 65.5786            |                 | 174 31 43     |  |
| 44<br>(9)              | 1   | .9402                          | 268          | +66    | 137    | 97.9799            | 264 55 34       | 175 16 23     |  |
|                        | 2   | .9474                          | 271          | +66    | 135    | .9909              | 57 54           | 17 24         |  |
|                        | 4   | .9433                          | 277          | +66    | 136    | .9821              | 51 58           | 12 59         |  |
|                        | 7   | .8776                          | 292          | —47    | 138    | .9071              | 51 50           | 15 42         |  |
|                        | 8   | .8822                          | 317          | —59    | 139    | .9141              | 53 0            | 19 53         |  |
|                        | 9   | .8862                          | 312          | —59    | 139    | .9134              | 56 20           | 18 56         |  |
|                        | 10  | .8748                          | 297          | —61    | 139    | .9010              | 56 10           | 19 3          |  |
|                        | 11  | .8674                          | 264          | +58    | 139    | .9000              | 265 0 26        | 21 26         |  |
|                        | 12  | .8668                          | 262          | +58    | 140    | .9070              | 264 58 52       | 21 37         |  |
|                        | 14  | .8757                          | 282          | +65    | 140    | .9215              | 265 0 42        | 21 4          |  |
|                        | 15  | .8552                          | 300          | —63    | 139    | .8852              | 1 7             | 20 18         |  |
|                        | 16  | .8522                          | 315          | —63    | 139    | .8829              | 0 14            | 19 32         |  |
|                        | 18  | .8559                          | 293          | +64    | 139    | .8992              | 6 2             | 22 33         |  |
|                        | 19  | .8486                          | 273          | +64    | 139    | .8930              | 6 4             | 23 10         |  |
|                        | 20  | .8400                          | 331          | +65    | 139    | .8806              | 5 46            | 23 56         |  |
|                        | 21  | .8808                          | 288          | +65    | 136    | .9193              | 7 20            | 25 47         |  |
|                        | 22  | .8776                          | 316          | +65    | 136    | .9133              | 5 16            | 23 25         |  |
|                        | 23  | .8574                          | 308          | —47    | 139    | .8918              | 3 23            | 23 38         |  |
|                        | 24  | .8664                          | 306          | —47    | 137    | .8900              | 3 8             | 22 8          |  |
|                        | 25  | .8569                          | 296          | —50    | 137    | .8821              | 4 32            | 23 44         |  |
|                        | 26  | .8557                          | 290          | —50    | 137    | .8849              | 3 47            | 22 37         |  |
|                        | 27  | .8500                          | 316          | —52    | 136    | .8870              | 5 0             | 24 3          |  |
|                        |     |                                |              |        | Means  | 97.9103            |                 | 175 20 53     |  |
| 45<br>(16)             | 6   | .1429                          | 37           | + 6    | 34     | 9.1477             | 208 13 4        | 118 41 1      |  |
|                        | 8   | .1377                          | 30           | — 6    | 34     | .1394              | 207 56 30       | 23 4          |  |
|                        | 9   | .1502                          | 32           | — 6    | 34     | .1525              | 57 26           | 20 56         |  |
|                        | 13  | .0788                          | 58           | + 6    | 33     | .0945              | 208 10 36       | 28 55         |  |
|                        | 15  | .0882                          | 37           | — 6    | 41     | .0962              | 207 58 2        | 17 20         |  |
|                        | 16  | .0817                          | 32           | — 6    | 33     | .0863              | 208 1 58        | 22 19         |  |
|                        | 17  | .0743                          | 34           | — 6    | 34     | .0860              | 1 20            | 17 39         |  |
|                        | 20  | .0283                          | 62           | + 6    | 37     | .0361              | 20 50           | 39 58         |  |
|                        | 22  | .0427                          | 59           | + 6    | 34     | .0342              | 20 15           | 36 24         |  |
|                        | 24  | .0478                          | 31           | — 4    | 37     | .0480              | 23 42           | 42 1          |  |
|                        | 25  | .0220                          | 32           | — 5    | 37     | .0287              | 21 8            | 38 52         |  |
|                        | 27  | .0550                          | 31           | — 5    | 34     | .0568              | 16 24           | 35 2          |  |
|                        |     |                                |              |        | Means  | 9.0839             |                 | 118 30 18     |  |
| 46<br>(39)             | 1   | .3827                          | 161          | +40    | 100    | 59.4006            | 257 35 44       | 167 57 2      |  |
|                        | 7   | .2952                          | 179          | —29    | 99     | .3209              | 33 2            | 56 26         |  |
|                        | 8   | .3118                          | 194          | —36    | 100    | .3244              | 34 28           | 168 1 16      |  |
|                        | 9   | .3124                          | 193          | —36    | 102    | .3350              | 36 30           | 167 58 51     |  |
|                        | 15  | .2822                          | 188          | —38    | 100    | .3033              | 42 30           | 168 1 39      |  |

TABLE V.—RESULTS OF THE MEASURES. (*Continued.*)

| No.                    | Pl. | Obs.<br>Dis-<br>tance<br>East. | Corrections. |        |        | Corrected<br>Mean. | Position Angle. |               |  |
|------------------------|-----|--------------------------------|--------------|--------|--------|--------------------|-----------------|---------------|--|
|                        |     |                                | Refrac.      | Aberr. | Scale. |                    | E. Observed.    | Mean, Corr'd. |  |
| 46<br>( <i>cont.</i> ) | 16  | .2818                          | 195          | —38    | 100    | 59.3082            | 257° 43' 8"     | 168° 1' 5"    |  |
|                        | 17  | .2806                          | 193          | —38    | 100    | .3040              | 42 15           | 1 23          |  |
|                        | 23  | .2660                          | 189          | —29    | 100    | .2926              | 46 47           | 6 54          |  |
|                        | 24  | .2737                          | 189          | —29    | 100    | .2974              | 46 45           | 5 7           |  |
|                        | 25  | .2750                          | 184          | —30    | 100    | .2931              | 47 35           | 6 58          |  |
|                        | 27  | .2612                          | 195          | —32    | 99     | .2872              | 47 42           | 6 50          |  |
|                        |     |                                |              |        | Means  | 59.3152            |                 | 168 2 8       |  |
| 47<br>(13)             | 1   | .6288                          | 99           | +23    | 116    | 33.6491            | 238 54 35       | 149 16 43     |  |
|                        | 3   | .6268                          | 94           | +23    | 116    | .6514              | 57 20           | 17 49         |  |
|                        | 4   | .6261                          | 92           | +23    | 114    | .6460              | 52 38           | 13 18         |  |
|                        | 5   | .5845                          | 136          | +22    | 117    | .6106              | 239 0 24        | 21 37         |  |
|                        | 6   | .5927                          | 108          | +22    | 114    | .6223              | 238 52 48       | 20 0          |  |
|                        | 7   | .5300                          | 116          | —16    | 116    | .5678              | 50 54           | 14 26         |  |
|                        | 8   | .5588                          | 112          | —20    | 116    | .5768              | 52 25           | 19 6          |  |
|                        | 9   | .5590                          | 114          | —20    | 116    | .5774              | 55 48           | 18 1          |  |
|                        | 10  | .5480                          | 115          | —21    | 114    | .5671              | 54 50           | 17 44         |  |
|                        | 11  | .5332                          | 110          | +20    | 116    | .5453              | 239 3 38        | 24 23         |  |
|                        | 12  | .5132                          | 100          | —20    | 116    | .5449              | 3 35            | 25 52         |  |
|                        | 13  | .5194                          | 159          | +22    | 120    | .5491              | 6 16            | 23 19         |  |
|                        | 15  | .5109                          | 118          | —21    | 120    | .5388              | 1 22            | 20 20         |  |
|                        | 16  | .5286                          | 115          | —22    | 120    | .5462              | 0 32            | 19 29         |  |
|                        | 17  | .5182                          | 117          | —22    | 120    | .5404              | 2 56            | 21 33         |  |
|                        | 18  | .4778                          | 142          | +22    | 116    | .5031              | 8 16            | 25 47         |  |
|                        | 19  | .4936                          | 121          | +22    | 116    | .5112              | 8 38            | 26 4          |  |
|                        | 21  | .5196                          | 136          | +22    | 116    | .5437              | 9 52            | 28 48         |  |
|                        | 22  | .5118                          | 162          | +22    | 121    | .5229              | 9 33            | 27 58         |  |
|                        | 23  | .4896                          | 109          | —16    | 116    | .5136              | 7 37            | 27 38         |  |
|                        | 24  | .5016                          | 112          | —16    | 116    | .5240              | 8 34            | 26 56         |  |
|                        | 25  | .4956                          | 112          | —17    | 116    | .5045              | 9 55            | 28 36         |  |
|                        | 26  | .4980                          | 114          | —17    | 116    | .5184              | 7 0             | 26 19         |  |
|                        | 27  | .4860                          | 114          | —18    | 114    | .5060              | 7 34            | 27 39         |  |
|                        |     |                                |              |        | Means  | 33.5575            |                 | 149 22 28     |  |
| 48<br>(38)             | 7   | .8952                          | 246          | —39    | 130    | 80.9302            | 255 29 3        | 165 53 25     |  |
|                        | 8   | .9108                          | 265          | —49    | 127    | .9402              | 30 40           | 57 49         |  |
|                        | 9   | .9053                          | 264          | —49    | 127    | .9277              | 34 44           | 56 41         |  |
|                        | 11  | .8963                          | 230          | —48    | 127    | .9206              | 39 6            | 166 0 15      |  |
|                        | 23  | .8800                          | 260          | —39    | 130    | .9050              | 41 2            | 2 4           |  |
|                        | 24  | .8652                          | 260          | —39    | 130    | .8988              | 42 10           | 1 8           |  |
|                        | 27  | .8562                          | 267          | —43    | 130    | .8837              | 42 57           | 2 36          |  |
|                        |     |                                |              |        | Means  | 80.9152            |                 | 165 59 8      |  |
| 49<br>(30)             | 4   | .2514                          | 359          | +82    | 118    | 122.3031           | 98 34 38        | 8 55 30       |  |
|                        | 7   | .3074                          | 378          | —59    | 117    | .3326              | 30 48           | 54 44         |  |
|                        | 8   | .3116                          | 383          | —74    | 117    | .3372              | 32 8            | 59 4          |  |
|                        | 9   | .3119                          | 373          | —74    | 117    | .3322              | 35 24           | 57 56         |  |
|                        | 10  | .3144                          | 355          | —76    | 117    | .3484              | 36 7            | 58 45         |  |
|                        | 12  | .2760                          | 336          | —72    | 116    | .3208              | 33 54           | 57 7          |  |
|                        | 15  | .3237                          | 364          | —79    | 118    | .3472              | 38 16           | 57 26         |  |

TABLE V.—RESULTS OF THE MEASURES. (Continued.)

| No.           | Pl. | Obs.<br>Dis-<br>tance<br>East. | Corrections. |        |        | Corrected<br>Mean. | Position Angle. |            |         |
|---------------|-----|--------------------------------|--------------|--------|--------|--------------------|-----------------|------------|---------|
|               |     |                                | Refrac.      | Aberr. | Scale. |                    | E. Observed.    | Mean,      | Corr'd. |
| 49<br>(cont.) | 16  | .3088                          | 378          | —78    | 117    | 122.3426           | 98° 37' 35"     | 8° 56' 27" |         |
|               | 17  | .3103                          | 376          | —78    | 117    | .3407              | 37 16           | 56 26      |         |
|               | 18  | .3096                          | 331          | —80    | 117    | .3475              | 39 25           | 56 14      |         |
|               | 22  | .2898                          | 343          | +81    | 116    | .3410              | 38 23           | 56 46      |         |
|               | 23  | .3007                          | 377          | —59    | 117    | .3462              | 35 53           | 56 51      |         |
|               | 24  | .2821                          | 368          | —59    | 117    | .3204              | 36 58           | 55 43      |         |
|               | 25  | .2982                          | 357          | —62    | 117    | .3315              | 37 42           | 56 55      |         |
|               | 26  | .3028                          | 352          | —62    | 116    | .3301              | 37 8            | 55 59      |         |
|               | 27  | .2996                          | 382          | —65    | 117    | .3306              | 38 32           | 57 21      |         |
|               |     |                                |              |        | Means  | 122.3345           |                 | 8 56 50    |         |
| 50<br>(21)    | 1   | .7462                          | 198          | +48    | 130    | 71.7773            | 253 27 48       | 163 49 20  |         |
|               | 7   | .6584                          | 222          | —35    | 126    | .6962              | 23 37           | 47 51      |         |
|               | 8   | .6633                          | 236          | —43    | 130    | .6924              | 25 43           | 52 39      |         |
|               | 9   | .6752                          | 236          | —43    | 130    | .7028              | 28 6            | 50 59      |         |
|               | 15  | .6474                          | 231          | —46    | 129    | .6702              | 33 50           | 52 55      |         |
|               | 16  | .6326                          | 238          | —46    | 129    | .6610              | 34 28           | 53 16      |         |
|               | 23  | .6194                          | 231          | —35    | 128    | .6499              | 36 44           | 57 1       |         |
|               | 24  | .6235                          | 231          | —35    | 128    | .6545              | 38 25           | 56 37      |         |
|               | 25  | .6235                          | 227          | —36    | 127    | .6551              | 39 32           | 58 6       |         |
|               | 27  | .6134                          | 237          | —38    | 127    | .6371              | 38 24           | 57 10      |         |
|               |     |                                |              |        | Means  | 71.6797            |                 | 163 53 35  |         |
| 51<br>(43)    | 7   | .1809                          | 257          | —38    | 124    | 79.2114            | 106 16 8        | 16 40 29   |         |
| 52<br>(10)    | 1   | .5828                          | 279          | +68    | 127    | 101.6250           | 253 53 48       | 164 14 32  |         |
|               | 2   | .5836                          | 277          | +69    | 128    | .6284              | 57 4            | 16 7       |         |
|               | 4   | .5793                          | 281          | +69    | 128    | .6199              | 51 25           | 11 50      |         |
|               | 6   | .5711                          | 289          | +67    | 127    | .6131              | 49 10           | 16 29      |         |
|               | 7   | .5194                          | 313          | —49    | 126    | .5494              | 49 8            | 13 14      |         |
|               | 8   | .5315                          | 333          | —62    | 126    | .5613              | 50 30           | 17 23      |         |
|               | 9   | .5312                          | 335          | —62    | 127    | .5596              | 53 20           | 15 58      |         |
|               | 10  | .5176                          | 319          | —63    | 127    | .5422              | 53 46           | 16 35      |         |
|               | 11  | .4934                          | 292          | +60    | 128    | .5366              | 58 23           | 19 3       |         |
|               | 12  | .4992                          | 277          | +60    | 128    | .5386              | 56 32           | 19 1       |         |
|               | 14  | .4879                          | 325          | +68    | 128    | .5351              | 59 24           | 19 17      |         |
|               | 15  | .4806                          | 327          | —65    | 128    | .5098              | 59 38           | 18 20      |         |
|               | 16  | .4778                          | 337          | —66    | 128    | .5087              | 58 10           | 17 4       |         |
|               | 17  | .5040                          | 336          | —66    | 128    | .5373              | 58 24           | 17 30      |         |
|               | 18  | .4694                          | 347          | +66    | 127    | .5310              | 254 2 44        | 20 3       |         |
|               | 19  | .4724                          | 311          | +66    | 128    | .5145              | 4 2             | 20 54      |         |
|               | 20  | .4513                          | 412          | +68    | 128    | .5045              | 2 42            | 20 48      |         |
|               | 21  | .4980                          | 339          | +67    | 128    | .5405              | 4 42            | 23 8       |         |
|               | 22  | .4962                          | 391          | +68    | 128    | .5308              | 2 20            | 20 36      |         |
|               | 23  | .4802                          | 327          | —49    | 128    | .5188              | 0 32            | 20 53      |         |
|               | 24  | .4652                          | 327          | —49    | 128    | .5063              | 0 58            | 19 50      |         |
|               | 25  | .4708                          | 321          | —51    | 128    | .4986              | 2 15            | 21 24      |         |
|               | 26  | .4750                          | 316          | —51    | 128    | .5058              | 0 30            | 19 21      |         |
|               | 27  | .4694                          | 335          | —54    | 127    | .5008              | 1 48            | 21 12      |         |
|               |     |                                |              |        | Means  | 101.5424           |                 | 164 18 21  |         |

TABLE V.—RESULTS OF THE MEASURES. (*Continued.*)

| No.        | Pl. | Obs.<br>Dis-<br>tance<br>East. | Corrections. |        |        | Corrected<br>Mean. | Position Angle. |               |
|------------|-----|--------------------------------|--------------|--------|--------|--------------------|-----------------|---------------|
|            |     |                                | Refrac.      | Aberr. | Scale. |                    | E. Observed.    | Mean, Corr'd. |
| 53<br>(20) | 1   | .5200                          | 184          | —43    | 112    | 63.5544            | 241° 25' 44"    | 151° 47' 8"   |
|            | 7   | .4407                          | 216          | —31    | 110    | .4738              | 21 8            | 44 59         |
|            | 8   | .4534                          | 210          | —38    | 112    | .4794              | 22 35           | 49 26         |
|            | 9   | .4516                          | 215          | —38    | 112    | .4806              | 25 42           | 48 29         |
|            | 10  | .4502                          | 214          | —39    | 112    | .4708              | 26 15           | 48 32         |
|            | 11  | .4224                          | 203          | —38    | 112    | .4519              | 32 2            | 52 29         |
|            | 15  | .4202                          | 219          | —41    | 115    | .4494              | 30 4            | 49 57         |
|            | 16  | .4008                          | 216          | —41    | 115    | .4286              | 30 50           | 49 17         |
|            | 19  | .3873                          | 221          | —41    | 112    | .4147              | 38 20           | 54 49         |
|            | 23  | .4041                          | 206          | —31    | 112    | .4266              | 33 12           | 53 44         |
|            | 24  | .4042                          | 210          | —31    | 112    | .4217              | 32 50           | 52 15         |
|            | 25  | .4024                          | 210          | —33    | 112    | .4232              | 35 56           | 54 35         |
|            | 27  | .3931                          | 214          | —34    | 110    | .4215              | 34 55           | 54 9          |
|            |     |                                |              |        | Means  | 63.4536            |                 | 151 50 45     |
| 54<br>(33) | 7   | .2196                          | 304          | —44    | 138    | 92.2483            | 107 58 5        | 18 22 22      |
|            | 8   | .2086                          | 283          | —56    | 138    | .2416              | 58 22           | 25 39         |
|            | 11  | .1764                          | 259          | —55    | 138    | .2280              | 108 2 26        | 23 35         |
|            | 15  | .2108                          | 276          | —59    | 138    | .2340              | 3 14            | 22 53         |
|            | 16  | .2254                          | 281          | —59    | 138    | .2540              | 3 12            | 22 30         |
|            | 17  | .2142                          | 278          | —59    | 138    | .2355              | 2 45            | 22 16         |
|            | 23  | .1922                          | 278          | —45    | 138    | .2187              | 2 13            | 22 32         |
|            | 24  | .1952                          | 272          | —45    | 138    | .2251              | 1 52            | 20 58         |
|            | 25  | .1869                          | 266          | —47    | 138    | .2209              | 3 24            | 22 34         |
|            | 26  | .2041                          | 266          | —47    | 143    | .2398              | 2 44            | 21 46         |
|            | 27  | .1870                          | 283          | —49    | 142    | .2201              | 4 23            | 23 5          |
|            |     |                                |              |        | Means  | 92.2333            |                 | 18 22 45      |
| 55<br>(31) | 4   | .4406                          | 361          | —82    | 114    | 121.4839           | 105 1 43        | 15 22 21      |
|            | 6   | .4420                          | 340          | —79    | 108    | .4798              | 104 56 15       | 24 3          |
|            | 7   | .4702                          | 391          | —58    | 119    | .5030              | 57 22           | 21 40         |
|            | 8   | .4680                          | 374          | —73    | 119    | .4960              | 58 56           | 25 58         |
|            | 9   | .4697                          | 367          | —73    | 119    | .4978              | 105 1 38        | 24 37         |
|            | 10  | .4623                          | 352          | —75    | 119    | .4955              | 2 46            | 25 25         |
|            | 11  | .4332                          | 333          | —72    | 114    | .4742              | 2 42            | 23 54         |
|            | 12  | .4254                          | 342          | —72    | 118    | .4781              | 0 26            | 23 32         |
|            | 14  | .4561                          | 334          | —80    | 118    | .4949              | 3 46            | 24 33         |
|            | 15  | .4763                          | 362          | —77    | 116    | .4966              | 5 24            | 24 13         |
|            | 16  | .4810                          | 372          | —78    | 114    | .5059              | 3 46            | 23 0          |
|            | 17  | .4742                          | 368          | —78    | 114    | .5032              | 3 33            | 23 1          |
|            | 18  | .4607                          | 327          | —80    | 119    | .5091              | 5 32            | 22 36         |
|            | 19  | .4584                          | 331          | —80    | 119    | .5095              | 6 4             | 23 19         |
|            | 20  | .4668                          | 333          | +81    | 114    | .5112              | 5 50            | 24 5          |
|            | 22  | .4550                          | 332          | —81    | 112    | .4928              | 4 58            | 23 36         |
|            | 23  | .4708                          | 369          | —59    | 114    | .5027              | 2 44            | 23 26         |
|            | 24  | .4665                          | 361          | —59    | 114    | .4885              | 3 33            | 22 5          |
|            | 25  | .4586                          | 351          | —62    | 114    | .4899              | 4 25            | 23 37         |
|            | 26  | .4569                          | 350          | —62    | 114    | .4887              | 3 54            | 22 29         |
|            | 27  | .4610                          | 375          | —65    | 113    | .4901              | 5 28            | 24 26         |
|            |     |                                |              |        | Means  | 121.4948           |                 | 15 23 37      |

TABLE V.—RESULTS OF THE MEASURES. (*Continued.*)

| No.        | Pl. | Obs.<br>Dis-<br>tance<br>East. | Corrections. |        |        | Corrected<br>Mean. | Position Angle. |             |         |
|------------|-----|--------------------------------|--------------|--------|--------|--------------------|-----------------|-------------|---------|
|            |     |                                | Refrac.      | Aberr. | Scale. |                    | E. Observed.    | Mean.       | Corr'd. |
| 56<br>(32) | 7   | .7760                          | 395          | —59    | 117    | 122.8121           | 104° 58' 16"    | 15° 22' 36" |         |
|            | 9   | .7907                          | 374          | —75    | 117    | .8186              | 105 3 0         | 25 53       |         |
|            | 10  | .7814                          | 356          | —76    | 116    | .8092              | 4 14            | 26 46       |         |
|            | 11  | .7322                          | 338          | —73    | 117    | .7870              | 3 46            | 25 0        |         |
|            | 12  | .7300                          | 346          | —73    | 116    | .7773              | 1 5             | 24 35       |         |
|            | 17  | .7907                          | 372          | —79    | 117    | .8116              | 5 7             | 24 7        |         |
|            | 23  | .7672                          | 373          | —60    | 117    | .7992              | 4 8             | 24 56       |         |
|            | 24  | .7730                          | 365          | —60    | 117    | .7963              | 4 34            | 23 20       |         |
|            | 25  | .7616                          | 354          | —63    | 117    | .7898              | 5 38            | 24 48       |         |
|            | 26  | .7576                          | 352          | —63    | 112    | .7904              | 4 48            | 23 44       |         |
|            | 27  | .7614                          | 379          | —65    | 111    | .7910              | 6 18            | 25 28       |         |
|            |     |                                |              |        | Means  | 122.7984           |                 | 15 24 39    |         |
| 57<br>(22) | 1   | .3810                          | 209          | —49    | 129    | 72.4157            | 240 5 48        | 150 26 10   |         |
|            | 7   | .2864                          | 248          | —35    | 129    | .3250              | 0 16            | 23 43       |         |
|            | 8   | .3166                          | 240          | —44    | 129    | .3436              | 1 25            | 28 24       |         |
|            | 9   | .3242                          | 245          | —44    | 129    | .3446              | 4 20            | 26 39       |         |
|            | 15  | .2574                          | 252          | —46    | 132    | .2943              | 9 16            | 28 1        |         |
|            | 16  | .2686                          | 248          | —47    | 132    | .2985              | 9 34            | 28 26       |         |
|            | 23  | .2635                          | 235          | —35    | 129    | .2746              | 11 2            | 32 7        |         |
|            | 25  | .2382                          | 241          | —37    | 129    | .2008              | 15 10           | 33 26       |         |
|            | 27  | .2430                          | 245          | —38    | 128    | .2636              | 13 22           | 32 16       |         |
|            |     |                                |              |        | Means  | 72.3134            |                 | 150 28 48   |         |
| 58<br>(15) | 4   | .1760                          | 133          | —32    | 118    | 48.1916            | 208 58 6        | 119 19 7    |         |
|            | 6   | .1200                          | 194          | —32    | 114    | .1427              | 57 14           | 25 8        |         |
|            | 8   | .1102                          | 158          | —29    | 116    | .1305              | 56 40           | 23 42       |         |
|            | 11  | .0500                          | 205          | —28    | 117    | .0802              | 209 5 0         | 26 14       |         |
|            | 12  | .0270                          | 179          | —28    | 114    | .0579              | 2 56            | 26 8        |         |
|            | 15  | .0538                          | 195          | —31    | 120    | .0818              | 4 24            | 23 22       |         |
|            | 16  | .0434                          | 168          | —31    | 120    | .0732              | 2 50            | 22 3        |         |
|            | 17  | .0415                          | 179          | —31    | 118    | .0675              | 3 4             | 22 33       |         |
|            | 22  | .9971                          | 311          | —32    | 119    | .0489              | 8 28            | 26 42       |         |
|            | 23  | .9908                          | 154          | —23    | 117    | .0254              | 5 38            | 26 23       |         |
|            | 24  | .0192                          | 165          | —23    | 117    | .0450              | 7 47            | 26 13       |         |
|            | 25  | .9944                          | 172          | —24    | 117    | .0270              | 8 22            | 27 19       |         |
|            | 27  | .0204                          | 164          | —26    | 114    | .0371              | 7 54            | 27 10       |         |
|            |     |                                |              |        | Means  | 48.0776            |                 | 119 24 46   |         |
| 59<br>(41) | 7   | .5242                          | 309          | —40    | 134    | 83.5670            | 120 12 56       | 30 38 5     |         |
|            | 8   | .5354                          | 253          | —51    | 136    | .5594              | 15 36           | 42 0        |         |
|            | 17  | .5186                          | 252          | —54    | 139    | .5507              | 18 54           | 38 46       |         |
|            | 25  | .4874                          | 240          | —43    | 136    | .5191              | 19 42           | 39 19       |         |
|            |     |                                |              |        | Means  | 83.5491            |                 | 30 39 32    |         |
| 60<br>(12) | 1   | .7706                          | 237          | —44    | 112    | 64.8060            | 203 11 58       | 113 32 58   |         |
|            | 6   | .7352                          | 272          | —43    | 107    | .7601              | 7 15            | 34 36       |         |
|            | 8   | .7206                          | 211          | —39    | 112    | .7481              | 7 2             | 34 39       |         |
|            | 9   | .7302                          | 225          | —39    | 112    | .7561              | 10 12           | 33 3        |         |
|            | 11  | .6500                          | 286          | —38    | 112    | .6885              | 15 28           | 35 41       |         |

TABLE V.—RESULTS OF THE MEASURES. (*Continued.*)

| No.                           | Pl. | Obs.<br>Dis-<br>tance<br>East. | Corrections. |        |        | Corrected<br>Mean. | Position Angle. |              |         |
|-------------------------------|-----|--------------------------------|--------------|--------|--------|--------------------|-----------------|--------------|---------|
|                               |     |                                | Refrac.      | Aberr. | Scale. |                    | E. Observed.    | Mean.        | Corr'd. |
| <b>60</b><br>( <i>cont.</i> ) | 12  | .6514                          | 249          | +38    | 112    | 64.6868            | 203° 12' 52"    | 113° 34' 57" |         |
|                               | 13  | .6286                          | 419          | +43    | 112    | .6774              | 17 52           | 34 42        |         |
|                               | 14  | .6487                          | 341          | +43    | 113    | .6938              | 14 20           | 34 35        |         |
|                               | 15  | .6624                          | 267          | —41    | 118    | .6929              | 13 10           | 32 36        |         |
|                               | 16  | .6461                          | 226          | —42    | 114    | .6811              | 13 55           | 33 7         |         |
|                               | 17  | .6548                          | 241          | —42    | 114    | .6782              | 12 57           | 32 37        |         |
|                               | 18  | .5931                          | 376          | +42    | 112    | .6435              | 16 6            | 33 27        |         |
|                               | 20  | .5914                          | 446          | +43    | 112    | .6506              | 16 50           | 35 17        |         |
|                               | 22  | .6270                          | 427          | +43    | 114    | .6636              | 17 36           | 35 55        |         |
|                               | 23  | .6318                          | 205          | —31    | 112    | .6613              | 15 4            | 36 8         |         |
|                               | 24  | .6368                          | 221          | —31    | 112    | .6620              | 15 20           | 34 49        |         |
|                               | 25  | .6164                          | 233          | —33    | 112    | .6483              | 17 45           | 36 15        |         |
|                               | 27  | .6356                          | 219          | —34    | 107    | .6553              | 17 22           | 36 23        |         |
|                               |     |                                |              |        | Means  | 64.6919            |                 | 113 34 32    |         |
| <b>61</b><br>(17)             | 8   | .6645                          | 233          | —43    | 130    | 71.6909            | 201 5 8         | 111 32 50    |         |
|                               | 9   | .6765                          | 249          | —43    | 130    | .6979              | 8 55            | 31 23        |         |
|                               | 11  | .5761                          | 319          | +42    | 130    | .6290              | 12 50           | 33 35        |         |
|                               | 12  | .5901                          | 278          | +42    | 130    | .6305              | 10 36           | 32 59        |         |
|                               | 14  | .6000                          | 381          | +48    | 138    | .6417              | 11 34           | 32 50        |         |
|                               | 15  | .5767                          | 297          | —46    | 144    | .6262              | 11 5            | 30 57        |         |
|                               | 16  | .5857                          | 249          | —46    | 140    | .6230              | 10 56           | 30 11        |         |
|                               | 17  | .5706                          | 266          | —46    | 142    | .6106              | 11 48           | 30 46        |         |
|                               | 18  | .5557                          | 418          | +47    | 130    | .6114              | 15 2            | 32 12        |         |
|                               | 21  | .5838                          | 404          | +48    | 140    | .6458              | 16 6            | 35 44        |         |
|                               | 22  | .5494                          | 474          | +48    | 138    | .5967              | 16 14           | 34 4         |         |
|                               | 23  | .5739                          | 226          | —35    | 136    | .6000              | 13 30           | 34 2         |         |
|                               | 24  | .5584                          | 244          | —35    | 136    | .5924              | 13 38           | 32 30        |         |
|                               | 25  | .5390                          | 258          | —36    | 136    | .5769              | 15 2            | 34 24        |         |
|                               | 26  | .5500                          | 287          | —36    | 136    | .5913              | 13 22           | 32 5         |         |
|                               | 27  | .5699                          | 241          | —38    | 126    | .5976              | 15 18           | 34 15        |         |
|                               |     |                                |              |        | Means  | 71.6226            |                 | 111 32 48    |         |
| <b>62</b><br>(1)              | 1   | .3384                          | 341          | —73    | 119    | 108.3824           | 225 48 44       | 136 9 12     |         |
|                               | 2   | .3321                          | 314          | —73    | 116    | .3743              | 51 30           | 10 41        |         |
|                               | 3   | .3330                          | 294          | —73    | 123    | .3770              | 50 8            | 10 57        |         |
|                               | 4   | .3283                          | 293          | —73    | 119    | .3705              | 46 32           | 6 50         |         |
|                               | 5   | .2932                          | 502          | —71    | 116    | .3493              | 49 4            | 11 17        |         |
|                               | 6   | .2982                          | 383          | —71    | 116    | .3467              | 43 50           | 11 3         |         |
|                               | 7   | .2758                          | 424          | —52    | 123    | .3168              | 43 22           | 7 18         |         |
|                               | 8   | .2754                          | 361          | —65    | 123    | .3045              | 45 20           | 12 20        |         |
|                               | 9   | .2780                          | 375          | —65    | 119    | .3061              | 47 37           | 10 17        |         |
|                               | 10  | .2664                          | 397          | —67    | 119    | .2986              | 48 5            | 10 39        |         |
|                               | 11  | .2122                          | 403          | —64    | 123    | .2585              | 52 0            | 13 1         |         |
|                               | 12  | .2106                          | 355          | —64    | 119    | .2545              | 50 30           | 12 59        |         |
|                               | 13  | .2150                          | 606          | +72    | 124    | .2797              | 57 54           | 13 55        |         |
|                               | 14  | .2137                          | 482          | +72    | 125    | .2738              | 52 43           | 12 35        |         |
|                               | 15  | .2132                          | 410          | —69    | 117    | .2500              | 52 32           | 11 29        |         |
|                               | 16  | .2202                          | 378          | —70    | 125    | .2544              | 50 57           | 9 53         |         |
|                               | 17  | .2186                          | 395          | —70    | 125    | .2504              | 52 40           | 11 25        |         |

TABLE V.—RESULTS OF THE MEASURES. (*Concluded.*)

| No.                           | Pl. | Obs.<br>Dis-<br>tance<br>East. | Corrections. |        |        | Corrected<br>Mean. | Position Angle. |              |         |
|-------------------------------|-----|--------------------------------|--------------|--------|--------|--------------------|-----------------|--------------|---------|
|                               |     |                                | Refrac.      | Aberr. | Scale. |                    | E. Observed.    | Mean.        | Corr'd. |
| <b>62</b><br>( <i>cont.</i> ) | 18  | .1779                          | 534          | +71    | 119    | 108.2364           | 225° 55' 46"    | 136° 12' 35" |         |
|                               | 19  | .1592                          | 448          | +71    | 119    | .2175              | 56 35           | 13 24        |         |
|                               | 20  | .1584                          | 651          | +72    | 125    | .2272              | 55 50           | 14 1         |         |
|                               | 21  | .1864                          | 559          | +72    | 116    | .2536              | 58 10           | 16 26        |         |
|                               | 22  | .1734                          | 618          | +72    | 120    | .2279              | 56 50           | 14 54        |         |
|                               | 23  | .1962                          | 352          | —52    | 118    | .2315              | 53 30           | 14 1         |         |
|                               | 24  | .1898                          | 369          | —52    | 119    | .2252              | 54 40           | 13 19        |         |
|                               | 25  | .1912                          | 376          | —55    | 118    | .2192              | 55 15           | 14 26        |         |
|                               | 26  | .1848                          | 396          | —55    | 116    | .2215              | 54 12           | 13 2         |         |
|                               | 27  | .1777                          | 372          | —57    | 116    | .2106              | 55 22           | 14 47        |         |
|                               |     |                                |              |        | Means  | 108.2784           |                 | 136 12 6     |         |
| <b>63</b><br>(18)             | 17  | .6284                          | 311          | —54    | 144    | 83.6674            | 200 11 24       | 110 30 31    |         |
|                               | 23  | .5974                          | 264          | —41    | 140    | .6181              | 12 34           | 33 3         |         |
|                               | 25  | .5738                          | 300          | —43    | 140    | .6142              | 14 24           | 33 36        |         |
|                               | 27  | .5988                          | 282          | —44    | 136    | .6306              | 14 40           | 33 52        |         |
|                               |     |                                |              |        | Means  | 83.6326            |                 | 110 32 46    |         |

TABLE VI.—MEAN RESULTS.

| No. | Mag. | Epoch<br>1870+ | Distance. | Position<br>Angle. | $\alpha' - \alpha$ | $\delta' - \delta$ | Bonn-<br>Durch.    |
|-----|------|----------------|-----------|--------------------|--------------------|--------------------|--------------------|
| 1   |      | 2.249          | 3137.45   | 259 14 52          | -5654.45           | -620.81            |                    |
| 2   | 7.9  | 1.957          | 4009.14   | 311 39 38          | -5631.66           | +2630.50           | 57°130             |
| 3   | 9.2  | 3.226          | 3580.72   | 239 24 52          | -5603.15           | -1857.06           | 56°111             |
| 4   | 7.8  | 2.641          | 3079.63   | 254 11 9           | -5425.43           | -871.95            | 56°112             |
| 5   |      | 3.117          | 3106.22   | 293 30 26          | -5297.73           | +1208.19           |                    |
| 6   |      | 1.982          | 2951.29   | 285 55 41          | -5261.16           | +779.49            |                    |
| 7   | 9.4  | 2.883          | 2870.27   | 260 34 51          | -5199.01           | -499.71            | 56°113             |
| 8   | 9.4  | 2.896          | 2908.92   | 256 1 45           | -5174.05           | -732.02            | 56°114             |
| 9   |      | 1.982          | 2849.56   | 283 49 34          | -5124.60           | +652.08            |                    |
| 10  | 9.4  | 2.685          | 3513.62   | 231 32 24          | -4987.89           | -2213.24           | 56°117             |
| 11  |      | 2.391          | 3254.92   | 235 7 52           | -4853.07           | -1887.17           |                    |
| 12  | 9.5  | 1.957          | 3753.82   | 317 18 2           | -4790.17           | +2733.87           | 57°134             |
| 13  |      | 2.849          | 2541.89   | 268 51 53          | -4681.03           | -74.58             |                    |
| 14  | 9.1  | 2.494          | 3706.90   | 222 43 45          | -4542.16           | -2746.17           | 56°119             |
| 15  |      | 1.982          | 2602.60   | 291 56 29          | -4481.00           | +950.43            |                    |
| 16  |      | 2.249          | 2613.97   | 302 2 36           | -4125.84           | +1368.23           |                    |
| 17  | 9.3  | 2.915          | 2049.47   | 260 51 12          | -3719.44           | -341.12            | 56°121             |
| 18  |      | 1.981          | 1974.64   | 249 18 2           | -3386.11           | -710.70            |                    |
| 19  | 8.0  | 2.599          | 1965.25   | 240 30 17          | -3129.38           | -978.50            | 56°123             |
| 20  |      | 1.981          | 1827.09   | 247 51 50          | -3102.66           | -699.15            |                    |
| 21  | 9.0  | 2.763          | 2821.18   | 325 19 9           | -3010.58           | +2310.09           | 57°137             |
| 22  |      | 1.990          | 1870.94   | 300 26 44          | -2993.58           | +938.20            |                    |
| 23  | 8.5  | 2.676          | 1694.83   | 295 43 23          | -2829.30           | +726.78            | 57°138             |
| 24  |      | 3.069          | 1554.90   | 224 49 14          | -2003.20           | -1107.39           |                    |
| 25  | 9.5  | 2.984          | 1179.49   | 295 13 37          | -1973.71           | +498.41            | 57°140             |
| 26  | 8.4  | 2.599          | 2108.94   | 210 50 10          | -1965.43           | -1815.14           | 56°126             |
| 27  |      | 1.982          | 2820.40   | 340 41 14          | -1754.05           | +2658.36           |                    |
| 28  | 9.4  | 1.957          | 1110.05   | 308 20 52          | -1612.64           | +685.85            | 57°143             |
| 29  | 9.3  | 2.590          | 2476.24   | 342 46 5           | -1376.32           | +2363.03           | 57°144             |
| 30  | 8.9  | 1.957          | 837.56    | 320 51 22          | -979.13            | +648.52            | 57°145             |
| 31  | 8.5  | 2.599          | 1142.08   | 203 40 30          | -838.56            | -1046.74           | 56°128             |
| 32  | 9.0  | 2.739          | 1197.14   | 338 7 30           | -828.88            | +1110.19           | 57°146             |
| 33  | 9.3  | 2.667          | 306.82    | 235 31 33          | -465.51            | -173.91            | 56°129             |
| 34  | 9.4  | 1.957          | 2356.89   | 354 54 41          | -392.17            | +2347.44           | 57°148             |
| 35  |      | 1.957          | 1375.97   | 353 43 19          | -280.17            | +1367.64           |                    |
| 36  | 8.8  | 2.737          | 2614.16   | 357 58 54          | -173.07            | +2612.51           | 57°149             |
| 37  | 3.8  | 2.000          |           |                    |                    |                    | $\eta$ Cassiopeiae |
| 38  |      | 2.006          | 1280.49   | 178 4 53           | +78.25             | -1279.78           |                    |
| 39  | 8.5  | 3.168          | 625.21    | 6 50 53            | +138.02            | +620.73            | 57°151             |
| 40  | 9.1  | 2.791          | 1323.86   | 3 19 40            | +143.05            | +1321.61           | 57°152             |



TABLE VI.—MEAN RESULTS. (*Concluded.*)

| No. | Mag. | Epoch<br>1870+ | Distance. | Position<br>Angle. | $\alpha' - \alpha$ | $\delta' - \delta$ | Bonn-<br>Durch. |
|-----|------|----------------|-----------|--------------------|--------------------|--------------------|-----------------|
| 41  | 9.0  | 2.599          | 2142.57   | 2 52 29            | + 201.26           | + 2139.83          | 57° 153         |
| 42  |      | 1.982          | 3294.12   | 1 55 35            | + 209.24           | + 3292.20          |                 |
| 43  | 8.7  | 2.611          | 1837.01   | 174 31 43          | + 318.43           | — 1828.76          | 56° 130         |
| 44  | 7.3  | 2.768          | 2742.70   | 175 20 53          | + 401.71           | — 2733.85          | 56° 131         |
| 45  | 9.4  | 3.016          | 254.46    | 118 30 18          | + 411.70           | — 121.63           | 57° 155         |
| 46  |      | 2.862          | 1661.56   | 168 2 8            | + 627.13           | — 1625.91          |                 |
| 47  | 9.3  | 2.645          | 940.03    | 149 22 28          | + 877.17           | — 809.76           | 56° 133         |
| 48  | 9.0  | 2.908          | 2266.63   | 165 59 8           | + 995.15           | — 2200.28          | 56° 134         |
| 49  | 8.5  | 2.942          | 3426.88   | 8 56 50            | + 1007.84          | + 3384.08          | 57° 156         |
| 50  | 9.0  | 2.845          | 2007.92   | 163 53 35          | + 1011.95          | — 1930.24          | 56° 135         |
| 51  |      | 1.957          | 2218.90   | 16 40 29           | + 1192.18          | + 2124.04          |                 |
| 52  | 8.7  | 2.728          | 2844.46   | 164 18 21          | + 1389.46          | — 2740.59          | 56° 136         |
| 53  | 9.4  | 2.808          | 1777.49   | 151 50 45          | + 1527.63          | — 1569.74          | 56° 137         |
| 54  | 9.5  | 3.215          | 2583.68   | 18 22 45           | + 1529.45          | + 2449.36          | 57° 157         |
| 55  | 7.9  | 2.893          | 3403.36   | 15 23 37           | + 1706.97          | + 3278.13          | 57° 158         |
| 56  | 8.8  | 3.075          | 3439.88   | 15 24 39           | + 1727.63          | + 3312.96          | 57° 159         |
| 57  |      | 2.722          | 2025.67   | 150 28 48          | + 1815.35          | — 1766.39          |                 |
| 58  | 9.0  | 2.895          | 1346.77   | 119 24 46          | + 2151.24          | — 666.53           | 56° 138         |
| 59  | 9.5  | 2.739          | 2340.41   | 30 39 32           | + 2233.05          | + 2007.84          |                 |
| 60  | 8.9  | 2.879          | 1812.18   | 113 34 32          | + 3044.09          | — 735.08           |                 |
| 61  | 8.5  | 3.194          | 2006.32   | 111 32 48          | + 3419.83          | — 749.83           |                 |
| 62  | 7.4  | 2.599          | 3033.14   | 136 12 6           | + 3806.22          | — 2205.49          | 56° 143         |
| 63  |      | 3.731          | 2342.75   | 110 32 46          | + 4017.55          | — 840.14           |                 |

TABLE VII.—CATALOGUE OF THE STARS ABOUT  $\eta$  CASSIOPELE.

| No. | No.<br>of<br>Plates. | Right Ascension 1872. |                 |                 | Precession. | Sec. Var. | Declination<br>1872. | Precession.      | Sec. Var.      |
|-----|----------------------|-----------------------|-----------------|-----------------|-------------|-----------|----------------------|------------------|----------------|
|     |                      | h                     | m               | s               | s           | s         | ° ' "                | "                | "              |
| 1   | 4                    | 0 35                  | 5.145           | +3.38570        | +.05840     |           | 56 57 49.69          | +19.8200         | — .0839        |
| 2   | 1                    | 0 35                  | 6.664           | +3.39701        | +.06066     |           | 57 52 1.00           | +19.8197         | — .0841        |
| 3   | 4                    | 0 35                  | 8.565           | +3.38212        | +.05756     |           | 56 37 13.44          | +19.8193         | — .0839        |
| 4   | 25                   | 0 35                  | 20.413          | +3.38710        | +.05825     |           | 56 53 38.55          | +19.8166         | — .0844        |
| 5   | 12                   | 0 35                  | 28.926          | +3.39544        | +.05973     |           | 57 28 18.69          | +19.8147         | — .0849        |
| 6   | 2                    | 0 35                  | 31.364          | +3.39433        | +.05947     |           | 57 21 9.99           | +19.8141         | — .0849        |
| 7   | 13                   | 0 35                  | 35.507          | +3.39058        | +.05859     |           | 56 59 50.79          | +19.8132         | — .0850        |
| 8   | 10                   | 0 35                  | 37.171          | +3.39005        | +.05845     |           | 56 55 58.48          | +19.8129         | — .0851        |
| 9   | 2                    | 0 35                  | 40.468          | +3.39525        | +.05940     |           | 57 19 2.58           | +19.8121         | — .0853        |
| 10  | 11                   | 0 35                  | 49.582          | +3.38692        | +.05750     |           | 56 31 17.26          | +19.8100         | — .0854        |
| 11  | 5                    | 0 35                  | 58.570          | +3.38931        | +.05777     |           | 56 36 43.33          | +19.8080         | — .0858        |
| 12  | 1                    | 0 36                  | 2.763           | +3.40596        | +.06100     |           | 57 53 44.37          | +19.8070         | — .0863        |
| 13  | 7                    | 0 36                  | 10.039          | +3.39717        | +.05907     |           | 57 6 55.92           | +19.8054         | — .0863        |
| 14  | 6                    | 0 36                  | 19.297          | +3.38945        | +.05727     |           | 56 22 24.33          | +19.8032         | — .0865        |
| 15  | 2                    | 0 36                  | 23.375          | +3.40274        | +.05983     |           | 57 24 0.93           | +19.8023         | — .0869        |
| 16  | 4                    | 0 36                  | 47.052          | +3.40778        | +.06024     |           | 57 30 58.73          | +19.7968         | — .0879        |
| 17  | 17                   | 0 37                  | 14.145          | +3.40573        | +.05914     |           | 57 2 29.38           | +19.7904         | — .0889        |
| 18  | 2                    | 0 37                  | 36.367          | +3.40770        | +.05901     |           | 56 56 19.80          | +19.7852         | — .0898        |
| 19  | 27                   | 0 37                  | 53.483          | +3.40927        | +.05891     |           | 56 51 52.00          | +19.7811         | — .0904        |
| 20  | 2                    | 0 37                  | 55.264          | +3.41053        | +.05910     |           | 56 56 31.35          | +19.7807         | — .0905        |
| 21  | 20                   | 0 38                  | 1.403           | +3.42250        | +.05127     |           | 57 46 40.59          | +19.7792         | — .0909        |
| 22  | 3                    | 0 38                  | 2.536           | +3.41757        | +.06027     |           | 57 23 48.72          | +19.7789         | — .0909        |
| 23  | 26                   | 0 38                  | 13.488          | +3.41843        | +.06017     |           | 57 20 17.28          | +19.7762         | — .0913        |
| 24  | 14                   | 0 39                  | 8.561           | +3.41982        | +.05912     |           | 56 49 43.11          | +19.7628         | — .0934        |
| 25  | 5                    | 0 39                  | 10.527          | +3.42610        | — .06028    |           | 57 16 28.91          | +19.7623         | — .0934        |
| 26  | 27                   | 0 39                  | 11.079          | +3.41759        | +.05868     |           | 56 37 55.36          | +19.7621         | — .0933        |
| 27  | 2                    | 0 39                  | 25.171          | +3.43661        | +.06193     |           | 57 52 28.86          | +19.7586         | — .0943        |
| 28  | 1                    | 0 39                  | 34.599          | +3.43040        | +.06052     |           | 57 19 36.35          | +19.7563         | — .0945        |
| 29  | 11                   | 0 39                  | 50.353          | +3.43929        | +.06184     |           | 57 47 33.53          | +19.7523         | — .0953        |
| 30  | 1                    | 0 40                  | 16.833          | +3.43656        | +.06072     |           | 57 18 59.02          | +19.7456         | — .0961        |
| 31  | 27                   | 0 40                  | 26.204          | +3.43142        | +.05954     |           | 56 50 43.76          | +19.7432         | — .0963        |
| 32  | 4                    | 0 40                  | 26.849          | +3.43985        | +.06108     |           | 57 26 40.69          | +19.7431         | — .0965        |
| 33  | 24                   | 0 40                  | 51.074          | +3.43843        | — .06028    |           | 57 5 16.59           | +19.7368         | — .0975        |
| 34  | 1                    | 0 40                  | 55.963          | +3.44919        | +.06214     |           | 57 47 17.94          | +19.7356         | — .0979        |
| 35  | 1                    | 0 41                  | 3.430           | +3.44638        | +.06141     |           | 57 30 58.14          | +19.7336         | — .0980        |
| 36  | 23                   | 0 41                  | 10.570          | +3.45247        | +.06235     |           | 57 51 43.01          | +19.7318         | — .0984        |
| 37  |                      | <b>0 41 22.108</b>    | <b>+3.44373</b> | <b>— .06048</b> |             |           | <b>57 8 10.50</b>    | <b>— 19.7287</b> | <b>— .0987</b> |
| 38  | 1                    | 0 41                  | 27.325          | +3.43947        | +.05960     |           | 56 46 50.72          | +19.7274         | — .0988        |
| 39  | 5                    | 0 41                  | 31.309          | +3.44756        | +.06096     |           | 57 18 31.23          | +19.7263         | — .0991        |
| 40  | 24                   | 0 41                  | 31.645          | +3.45041        | +.06148     |           | 57 30 12.11          | +19.7263         | — .0992        |

TABLE VII.—CATALOGUE OF THE STARS. (*Concluded*).

| No. | No.<br>of<br>Plates. | Right Ascension<br>1872. | Precession. | Sec. Var. | Declination<br>1872. | Precession. | Sec. Var. |
|-----|----------------------|--------------------------|-------------|-----------|----------------------|-------------|-----------|
|     |                      | h m s                    | s           | s         | ° ' "                | "           | "         |
| 41  | 27                   | 0 41 35.525              | +3.45434    | +0.06214  | 57 43 50.33          | +19.7252    | —0.0994   |
| 42  | 2                    | 0 41 36.057              | +3.45920    | +0.06305  | 58 3 2.70            | +19.7251    | —0.0996   |
| 43  | 22                   | 0 41 43.337              | +3.43967    | +0.05935  | 56 37 41.74          | +19.7231    | —0.0994   |
| 44  | 22                   | 0 41 48.889              | +3.43698    | +0.05871  | 56 22 36.65          | +19.7218    | —0.0995   |
| 45  | 12                   | 0 41 49.555              | +3.44735    | +0.06056  | 57 6 8.87            | +19.7217    | —0.0997   |
| 46  | 11                   | 0 42 3.917               | +3.44344    | +0.05952  | 56 41 4.59           | +19.7177    | —0.1001   |
| 47  | 24                   | 0 42 20.586              | +3.44910    | +0.06018  | 56 54 40.74          | +19.7132    | —0.1008   |
| 48  | 7                    | 0 42 28.451              | +3.44476    | +0.05923  | 56 31 30.22          | +19.7112    | —0.1011   |
| 49  | 16                   | 0 42 29.297              | +3.46775    | +0.06331  | 58 4 34.58           | +19.7109    | —0.1017   |
| 50  | 10                   | 0 42 29.571              | +3.44598    | +0.05942  | 56 36 0.26           | +19.7109    | —0.1011   |
| 51  | 1                    | 0 42 41.587              | +3.46428    | +0.06243  | 57 43 34.54          | +19.7076    | —0.1020   |
| 52  | 24                   | 0 42 54.739              | +3.44641    | +0.05896  | 56 22 29.91          | +19.7040    | —0.1021   |
| 53  | 13                   | 0 43 3.950               | +3.45240    | +0.05982  | 56 42 0.76           | +19.7016    | —0.1029   |
| 54  | 11                   | 0 43 4.071               | +3.46905    | +0.06276  | 57 48 59.86          | +19.7015    | —0.1034   |
| 55  | 21                   | 0 43 15.906              | +3.47442    | +0.06348  | 58 2 48.63           | +19.6983    | —0.1036   |
| 56  | 11                   | 0 43 17.283              | +3.47479    | +0.06351  | 58 3 23.46           | +19.6979    | —0.1037   |
| 57  | 9                    | 0 43 23.131              | +3.45439    | +0.05979  | 56 38 44.11          | +19.6962    | —0.1033   |
| 58  | 13                   | 0 43 45.524              | +3.46216    | +0.06070  | 56 57 3.97           | +19.6901    | —0.1044   |
| 59  | 4                    | 0 43 50.978              | +3.47425    | +0.06271  | 57 41 38.34          | +19.6886    | —0.1048   |
| 60  | 18                   | 0 44 45.047              | +3.47058    | +0.06089  | 56 55 55.42          | +19.6735    | —0.1068   |
| 61  | 16                   | 0 45 10.097              | +3.47420    | +0.06099  | 56 55 40.67          | +19.6664    | —0.1077   |
| 62  | 27                   | 0 45 35.856              | +3.47178    | +0.06009  | 56 31 25.01          | +19.6589    | —0.1085   |
| 63  | 4                    | 0 45 49.945              | +3.47964    | +0.06109  | 56 54 10.36          | +19.6546    | —0.1093   |

#### XIV.—*The Arachnida of Colorado.*

BY NATHAN BANKS.

Read March 25, 1895.

During the past few years I have received several collections of spiders and other arachnids from Colorado. The great proportion of them were collected at or near Fort Collins by Prof. C. P. Gillette and Mr. C. F. Baker. Indeed, I believe their collections are the largest that have ever been made by entomologists in one locality in this country. They have also sent some from other places in the State. Mr. L. M. Cockerell sent me some especially interesting forms from West Cliff.

Dr. Packard in 1875 collected some spiders in the State and they were described by Thorell and Emerton. Mr. Morrison also collected some arachnids and sent them to Simon; some of these have been described by Keyserling, others by Simon. Dr. Marx, in his catalogue, records some other species from the State.

Colorado presents an especially interesting arachnid fauna. To receive from the same locality *Lathrodectes mactans* and *Pæcilochoa montana*, *Pholcus pullulus* and *Ergane borealis* is not an ordinary occurrence. There are quite a number of species which are essentially northern in their distribution. Prominent among these boreal forms may be mentioned the following with their distribution :

- Pæcilochoa montana* Em. White Mts.; Ithaca, N. Y.; Colo.; Wash.
- Drassus robustus* Em. N. H.; N. Y.; Colo.; Wash.; Can.
- Gnaphosa conspersa* Thor. N. H.; Ithaca, N. Y.; Colo.; Wash.; Can.
- Gnaphosa brumalis* Thor. N. H.; Ithaca, N. Y.; Colo.; Can.
- Crustulina sticta* Cambr. N. H.; Mich.; Colo.
- Microneta 5-dentata* Em. N. H.; Ithaca, N. Y.; Colo.
- Epeira carbonaria* Koch. Labrador; Mt. Washington; Long's Peak.
- Epeira patagiata* Clerk. N. H.; N. Y.; Mich.; Colo.; Wash.; Can.
- Larinia borealis* Bks. N. H.; Colo.; Wash.
- Synæma obscura* Keys. Mt. Washington; Colo.
- Pardosa grænlandica* Thor. Labrador; White Mts.; Rocky Mts.

*Ergane borealis* Blk. N. H.; N. Y.; Mass.; Can.; Pa.; Wisc.; Colo.; Idaho; Wash.

*Icius similis* Bks. N. H.; Colo.; Wash.

*Attus monadnock* Em. White Mts.; Colo.

The western element is not prominent and is represented by such species as *Epeira gemma*, *Epeira aculeata*, *Xysticus discursans*, *Xysticus locuples*, *Bothriocyrtum californicum*, and *Sclerobunus robustus*. And these are mostly from western Colorado. Further collecting in the western portion of the State will doubtless increase the per cent. of Pacific forms.

There are a few typical southern spiders, such as *Lathrodectes mactans*, *Phidippus insolens*, *Pholcus pullulus*, *Thargalia amœna*, and *Centrurus carolinus*.

Quite a number are distributed throughout the entire United States—*Agalena nævia*, *Prosthesima atra*, *Xysticus gulosus*, *Coriarachne versicolor*, *Misumena vatia*, *Philæus militaris*, *Dendryphantes octavus*, *Theridium tepidariorum*, *Cyclosa conica*, *Epeira labyrinthica*, *Tetragnatha laboriosa*, *Steatoda borealis*, *Dictyna sublata*, *Chelifera cancrina*.

A few others are widely distributed over the entire eastern United States, east of the Rocky Mountains—*Plectana stellata*, *Argiope transversa*, *Lycosa carolinensis*, *Pisaura undata*, *Habrocestum cæcatum*, etc.

The most prominent characteristic is the great number of Thomisidæ; it appears to be the leading family, not only in species, but in specimens. But the micro-Therididæ, if thoroughly collected, would probably place the Therididæ in the lead of species. The absence of certain forms is quite peculiar; there are no long-legged Phalangidæ (*Liobunum*), the Clubionidæ are few in specimens and species, and there are no Anyphænæ; although many northern species are represented, *Tetragnatha extensa* is absent. Though the Lycosidæ are quite abundant, I have received but three specimens of Pirata. The Agalendæ are not near as common as one would naturally suppose. In the Attidæ we miss *Saitis*, *Marptusa* and *Epiblema*. Although some of these forms may be found with more extended collecting, yet it is not probable that they will appear so numerous as we find them elsewhere.

I append a list of places with altitudes at which collections were made; this has been prepared by Mr. C. F. Baker.

|                                      |  |
|--------------------------------------|--|
| Boulder, 5,400 ft.                   | Gray's Peak, 9,500 to 14,000 ft.       |
| Cañon City, 5,350 ft.                | Greenhorn, 5,000 ft.                   |
| Cameron Pass, 12,000 ft. ab. timber. | Horsetooth Gulch, 5,500 ft.            |
| Colorado Springs, 6,000 ft.          | Kelso's Cabin, 10,890 ft.              |
| Delta, 4,900 ft.                     | Leadville, 10,200 ft.                  |
| Denver, 5,200 ft.                    | Livermore, 7,000 ft.                   |
| Dixon's Cañon, 5,500 ft.             | Long's Peak, 12,000 ft., above timber. |
| Elk River, 7,000 ft.                 | Manitou, 6,350 ft.                     |
| Estes Park, 7,500 ft.                | Mt. Richtophen, 9,500 ft.              |
| Ft. Collins, 5,000 ft.               | Rist Cañon, 6,500 ft.                  |
| Four-Mile Hill, 7,000 ft.            | Steamboat Springs, 6,000 ft.           |
| Golden, 5,700 ft.                    | Swift Creek, 7,900 ft.                 |
| Grand Junction, 4,550 ft.            | Trinidad, 5,900 ft.                    |

Mr. Baker proposes the following terms: *sub-alpine*, up to 5,500 feet, or beginning of foot hills; *mid-alpine*, from sub-alpine to timber line; *high-alpine*, above timber line.

It will be found, however, in looking through the following pages that there is little difference between the sub-alpine and mid-alpine regions. But most of the southern and western forms occur at low latitudes; yet with them are mingled truly northern species.

#### THERAPHOSIDÆ.

**Bothriocyrum californicum** Cambr.

Recorded from the State by Simon.

**Eurypelma marxi** Sim.

One male, 25 mm. long, agrees well with Simon's description; it is black with some long fulvous hair on the abdomen; and reddish maxillæ and lip. Cañon City (Gillette).

#### HYPOCHILIDÆ.

**Hypochilus thorelli** Marx.

Recorded by Emerton from Colorado.

#### PHOLCIDÆ.

**Pholcophora americana** Bks.

Fort Collins, in house (Mrs. Baker).

**Pholcus pullulus** Hentz.

Recorded by Thorell from Manitou, July; Fort Collins under a board (Baker).

#### DRASSIDÆ.

**Micaria perfecta** Bks.

Fort Collins (Gillette), on lawn (Mrs. Baker).

**Micaria coloradensis** Bks.

Fort Collins, on lawn (Mrs. Baker).

**Drassus coloradensis** Em.

Described from Gray's Peak.

**Drassus humilis** Bks.

West Cliff (Cockerell).

**Drassus robustus** Em.

Ft. Collins, under stones, Nov., Dec. (Baker).

**Drassus inornatus** nov. sp.

Length ♀ 12 mm.; ceph. 3.9 mm. long, 2.9 mm. wide; patella plus tibia IV. 4.1 mm. Cephalothorax pale reddish-brown; legs and palpi yellow-brown, darker on metatarsi and tarsi; mandibles dark red-brown; sternum paler red-brown, darker on edges; abdomen above and below light gray, darker near the tip; spinnerets yellowish. Legs moderately hairy, no spines above on any of the tibiae, one below on tibia I.; metatarsi (except IV.) and tarsi with not very dense scopulas; fourth pair of legs quite long, the anterior pairs very short. Sternum narrow, nearly twice as long as broad. Posterior row of eyes procurved, longer than the anterior row; P. M. E. oval, more than their diameter apart, slightly nearer to each other than to P. S. E.; anterior row straight, A. M. E. the larger and nearer to the A. S. E. than to each other. The epigynum consists of a quadrangular cavity, broader behind than in front, from the anterior margin of which there projects a plate becoming quite wide, then tapering to a point near the posterior margin of the cavity.

One specimen, West Cliff. (Cockerell).

**Drassus assimilis** nov. sp.

Length ♂ 9.6 m. m.; ceph, 4 m. m. long; 3 m. m. wide; patella plus tibia I. 6.2 m. m. Cephalothorax, legs and palpi yellowish; sternum yellow-brown, darker on edges; palpal organ reddish; abdomen dark gray; spinnerets yellowish. The eyes are similar to *D. inornatus*. Sternum broad. Legs very long and slender; the scopulas moderately thick on the tarsi, but only on the tips of the metatarsi; no spine under tibia I., none above on tibia III., tibia IV. missing, femur IV. is a little shorter than femur I. The palpus has some resemblance to *D. coloradensis*, but the pointed projection on tibia is not so large, the tube of palpal organ is very much more curved, and, instead of a pointed tooth, there is a prominent foot-shaped appendage projecting beyond the side of tarsus. The sternum is too broad and the first legs too long to be the ♂ of *D. inornatus*.

Fort Collins (Gillette).

**Prosthesima atra** Hentz.

Fort Collins; under stones and leaves; sweeping alfalfa, May, Nov. Thorell records it from Manitou, July.

**Prosthesima ecclesiastica** Hentz.

Fort Collins (Gillette).

***Prothesima depressa* Em.**

One young specimen, Fort Collins (Baker).

***Prothesima blanda* Bks.**

Several females of this species have been collected at Fort Collins by Prof. Gillette. The epigynum consists of a reddish, nearly square area, divided behind into three lobes, the middle one, which is black, is nearly square and very much broader than both of the others together, which are narrowed toward their tips.

***Callilepis imbecilla* Keys.**

A young specimen under dead leaves, Fort Collins (Gillette).

***Pœcilochoera montana* Em.**

Fort Collins (Gillette).

***Pœcilochoera variegata* Hentz.**

Fort Collins (Gillette).

***Gnaphosa brumalis* Thor.**

Fort Collins (Baker).

***Gnaphosa conspersa* Thor.**

West Cliff (Cockerell). Thorell recorded it from Kelso's Cabin and Gray's Peak, July.

***Gnaphosa scudderi* Thor.**

Fort Collins (Gillette). Manitou, July (Thorell).

***Teminius nigriceps* nov. sp.**

Length ♀ 13 mm.; ceph. 4.5 mm. long, 3.8 mm. wide; patella plus tibia I. 4.1 mm., IV. 4 mm. Cephalothorax red brown, black around eyes and on clypeus; mandibles black; palpi red-brown, tips black; legs yellow-brown, I. and II. darker on tibiae and tarsi; maxillae red-brown; lip black; sternum red-brown, black on margins; abdomen dark gray, with two faint pale stripes above, spinnerets yellowish. Eyes, A. M. E. about their diameter apart, less than half so far from the equal A. S. E.; P. M. E. oval, less than their diameter apart, twice that distance from the P. S. E. Sternum broad. Legs hairy, fourth pair but little longer than the first; thick scopulas on all tarsi and metatarsi (except IV.); no spines on tibia I. and II., none above on tibia IV. Abdomen about twice as long as wide; the second joint of the superior spinnerets no longer than broad. The epigynum consists of a dark reddish, depressed elliptical area, broader than long, from the anterior margin of which there projects a broad median plate, broadest beyond the middle, and then suddenly tapering to a point, which does not quite attain the hind margin of the depression.

Two females, Fort Collins (Baker).



## CLUBIONIDÆ.

**Clubiona riparia** Koch (ornata Em.).

Fort Collins, under stones, Nov.; Steamboat Springs, July (Baker).

**Clubiona mœsta** Bks.

Fort Collins, on lawn (Mrs. Baker).

**Clubiona abbotti** Koch.

One female, Fort Collins (Gillette).

**Phrurolithus pugnatus** Em.

Recorded by Dr. Marx.

**Phrurolithus affinis** Bks.

Fort Collins, sifting dead leaves, February (Baker).

**Thargalia amœna** Koch.

Fort Collins (Baker), West Cliff (Cockerell).

**Thargalia tricolor** Koch.

Fort Collins, low herbage, May (Baker); West Cliff (Cockerell).

## DICTYNIDÆ.

**Dictyna sublata** Hentz.

*D. foliata* Keys. (?)

I think Keyserling's species is this common eastern species. Fort Collins, sweeping low herbage and alfalfa, May, June.

**Dictyna volucripes** Keys.

*D. arundinaceoides* Keys.

I fails to see any differences between these species. Fort Collins, Mt. Richtophen, Elk River, May, July.

**Amaurobius claustrarius** Koch.

Recorded by Dr. Marx.

## AGALENIDÆ.

**Agalena nævia** Hentz.

Fort Collins (Baker), West Cliff (Cockerell), Manitou (Packard). Not common.

**Tegenaria derhami** Scop.

Fort Collins, in house (Mrs. Baker).

**Cicurina arcuata** Keys.

Recorded by Dr. Marx.

**Cicurina robusta** Sim.

Described from the state.

**Cœlotes calcaratus** Keys.

Recorded by Dr. Marx.

**Cybaeus** sp.(?)

One female, Dixon's Cañon, March (Gillette).

**Hahnia** sp.(?)

Fort Collins, one young specimen looks much like *H. cinerea* ; among dead leaves (Gillette).

THERIDIDÆ.

**Theridium murarium** Em.

Recorded by Dr. Marx. Fort Collins, one young specimen (Baker).

**Theridium frondeum** Htz.

Fort Collins, young (Baker).

**Theridium puncto-sparsum** Keys.

Recorded by Dr. Marx.

**Theridium tepidariorum** Koch.

One young specimen from Fort Collins.

**Steatoda borealis** Hentz.

Fort Collins, sweeping low herbage ; under stones ; West Cliff ; May, November.

**Steatoda distincta** Thor.

Described from Manitou, June.

**Lithyphantes corollatus** Koch.

Fort Collins, Leadville, Estes Park. Thorell had it from Idaho Springs, Denver, Boulder and Manitou. June, July and August.

**Lithyphantes marmoratus** Hentz.

Recorded by Dr. Marx.

**Lithyphantes septem-maculatus** Keys.

Recorded by Dr. Marx.

**Euryopsis funebris** Hentz.

Fort Collins (Baker), West Cliff (Cockerell).

**Crustulina sticta** Cambr.

Fort Collins ; sweeping low herbage ; under stones ; among dead leaves. May, November.

**Lathrodectes mactans** Koch.

Fort Collins, quite common.

**Grammonota pictilis** Cambr.

Fort Collins, under a board ; among dead leaves. November.

**Cornicularia auranticeps** Em.

Fort Collins, sifting dead leaves, February (Baker).

**Cornicularia communis** Em.

Fort Collins, sifting leaves, February (Baker).

**Tmeticus** sp.?

One female, West Cliff.

**Tmeticus flaveolus** Bks.

Fort Collins, one male, under stones, February (Baker).

**Erigone coloradensis** Keys.

Described from the State.

**Erigone cacuminum** Thor.

Gray's Peak, under stones, July (Thorell).

**Erigone strabo** Thor.

Arapahoe Pass, 11-12,000 feet, July (Thorell). This and the preceding species do not belong to the genus as restricted; they are unknown to me.

**Tiso spirotubus** nov. sp.

Length 1.4 mm. Cephalothorax and sternum yellow-brown, abdomen black, with some small scattered white dots; legs and palpi pale yellowish. Cephalothorax low, broad in front, head ♂ quite suddenly, but only slightly elevated; the M. E. form a trapeze plainly longer than broad behind, the A. M. E. smaller than other eyes and nearly touching; mandibles small, unarmed; legs of moderate length, tarsi plainly shorter than the metatarsi, a small spine behind on the under-side of posterior coxæ of both sexes; sternum broadly triangular, sides rounded, obtusely pointed behind. The region of the epigynum projects below the venter, showing behind a transverse region rounded on sides and slightly divided in the middle. The male palpi are very long, the femur being nearly as long as the breadth of the cephalothorax, cylindrical and with a minute spine at extreme base; patella about one-half as long, gradually enlarged to tip, and with a small spine at base; tibia very short, but with a very long slender hook which is strongly curved toward tip; the tarsus is broadly triangular, above with a blunt projection at the angle where it touches the tibial hook, the bulb has a very long, tapering stylus of about five gradually enlarging coils.

Fort Collins, some under a board, others among dead leaves.

The genus *Tiso* is related to *Erigone*, but it differs in the structure of the ♂ palpus and in the weaker mandibles. In the European species the ♂ head is not elevated, but in this and in an allied species from Washington the head is distinctly elevated.

**Linyphia clathrata** Koch.

Fort Collins (Gillette).

**Linyphia orophila** Thor.

Gray's Peak, July (Packard).

**Linyphia phrygiana** Koch.

One specimen, Fort Collins (Gillette), West Cliff (Cockerell).

**Linyphia communis** Hentz.

Fort Collins, Steamboat Springs, July.

**Diplostyla nigra** Reuss.

Fort Collins, one female, sifting leaves, February (Baker).

**Lepthyphantes nebulosus** Blk.

Fort Collins, under a board (Baker).

**Lepthyphantes minutus** Blk.

Fort Collins (Baker).

**Bathyphantes zygia** Keys.

Fort Collins, sifting leaves, February (Baker).

**Microneta quinquedentata** Em.

Fort Collins, among leaves, November (Gillette).

EPEIRIDÆ.

**Epeira aculeata** Em.

Fort Collins, Steamboat Springs, Four-mile Hill, July. Gray's Peak (Emerton).

**Epeira carbonaroides** Keys.

Recorded by Dr. Marx. Probably same as *E. aculeata*.

**Epeira carbonaria** Koch.

Long's Peak, above timber, July, (Gillette).

**Epeira bivariolata** Keys.

Recorded by Dr. Marx.

**Epeira famulatoria** Keys.

Described from the State.

**Epeira gemma** McCook.

Fort Collins, Greenhorn, July (R. W. Sears).

**Epeira sylvatica** Em.

Fort Collins (Gillette); probably this species.

**Epeira nordmanni** Thor.?

Fort Collins (Gillette).

**Epeira strix** Hentz.

Fort Collins, sweeping low herbage, May.

**Epeira patagiata** Clerk.

Fort Collins (Gillette).

**Epeira trivittata** Keys.

One male, Fort Collins, June (Baker). Boulder, June (Thorell.)

**Eperia trifolium** Hentz.

Recorded by Dr. Marx.

**Epeira labyrinthea** Hentz.

Fort Collins, Steamboat Springs, Four-mile Hill, Elk River, July.

**Epeira parvula** Keys.

Fort Collins, sweeping low herbage, September (Gillette).

**Epeira displicata** Hentz.

Fort Collins, sweeping alfalfa; Steamboat Springs, May, July (Baker).

**Plectana stellata** Hentz.

Fort Collins, sweeping and under stone, November.

**Singa variabilis** Em.

Fort Collins, sweeping low herbage; Steamboat Springs, May, July (Baker).

**Argiope transversa** Em.

Fort Collins (Baker).

**Cyclosa conica** Pall.

Estes Park, July (Gillette). One specimen.

**Larinia borealis** Bks.

Three specimens, Fort Collins, sweeping, June.

**Tetragnatha grallator** Hentz.

Boulder, Manitou, Golden, July (Thorell). I have seen only some young specimens from Steamboat Springs, July (Baker).

**Tetragnatha laboriosa** Hentz.

Fort Collins, Steamboat Springs, Elk River, Mount Richthofen; sweeping, May, July. Very abundant.

**Pachygnatha autumnalis** Keys.

One female, Fort Collins, under stones, November (Baker).

**Pachygnatha brevis** Keys.

Fort Collins, low herbage, among dead leaves and under stones, September, November.

## THOMISID.E.

**Xysticus auctificus** Keys.

Described from the State.

**Xysticus benefactor** Keys.

Fort Collins, Steamboat Springs, July. Two specimens.

**Xysticus locuples** Keys.

Recorded by Keyserling.

**Xysticus gulosus** Keys.

Fort Collins, under stones and on low herbage. Quite common.

**Xysticus cunctator** Thor.

*X. quinquepunctatus* Keys.

*X. lenis* Keys.

Fort Collins, sweeping alfalfa, May, June; Boulder, July (Thorell). *X. lenis* is an immature form of *X. 5-punctatus*, which is, I think, Thorell's species. It is quite common.

**Xysticus discursans** Keys.

*X. pulverulentus* Em.

Fort Collins, sweeping low herbage, May; Dixon's Cañon, under stones, March.

**Xysticus funestus** Keys.

Recorded by Dr. Marx.

**Xysticus nigromaculatus** Keys.

One female, Fort Collins (Baker).

**Xysticus stomachosus** Keys.

Recorded by Dr. Marx.

**Xysticus quadrilineatus** Keys.

Fort Collins, under stones. Not uncommon.

**Xysticus montanensis** Keys.

*X. bimaculatus* Em.

One female, Fort Collins (Gillette).

**Xysticus limbatus** Keys.

Fort Collins, sweeping low herbage, September (Gillette).

**Xysticus formosus** Bks.

Fort Collins, one specimen not quite adult (Gillette).

**Xysticus vernilis** Keys.

West Cliff (Cockerell).

**Xysticus triguttatus** Keys.

Recorded by Dr. Marx. One female, Fort Collins, June (Baker).

**Xysticus gramineus** Em.

Fort Collins, one male, sweeping low herbage, May (Baker).

**Oxyptila conspurcata** Thor.

Fort Collins, under stones, November (Baker). Manitou, July (Thorell).

**Coriarachne versicolor** Keys.

Fort Collins; Rist Cañon, April.

**Synæma obscura** Keys.

Elk River, July (Baker); West Cliff (Cockerell).

**Misumena vatia** Clerk.

Fort Collins, Steamboat Springs, Moon's Ranch, June, July.  
Common.

**Misumena lepida** Thor.

Fort Collins, sweeping, May.

**Misumena rosea** Keys.

Fort Collins, sweeping, May. Quite common.

**Misumena oblonga** Keys.

Fort Collins, Dixon's Cañon, sweeping, May.

**Misumena spinosa** Keys.

Fort Collins, sweeping, June, one male (Baker).

**Tibellus oblongus** Walck.

Fort Collins, Steamboat Springs, Mount Richtophen, sweeping, May, July.

**Thanatus rubicundus** Keys.

*Th. coloradensis* Keys.

Fort Collins, Dixon's Cañon, under stones, March, November, December. This species is quite variable in size and markings.

**Philodromus alaskensis** Keys.

What I consider as this species is very common in Colorado, but most of the specimens taken by sweeping are young. Fort Collins, May, September.

**Philodromus spectabilis** Keys.

Described from the State.

**Philodromus aureolus** Walck.

Fort Collins, Steamboat Springs, May, July; Manitou (Thorell).

**Philodromus lentiginosus** Keys.

One female of this beautiful species was taken by Mr. Baker under Mount Richtophen, in July; it was previously known only from Lake Superior.

**Philodromus praelustris** Keys.

Described from the State.

**Philodromus inquisitor** Thor.

Kelso's Cabin (Thorell). Unknown to me, quite probably the same as the preceeding. Emerton records it from Laggan.

**Philodromus satullus** Keys.

Fort Collins, sweeping, June (Baker).

**Philodromus virescens** Thor.

*Ph. clarus* Keys.

Fort Collins, a young specimen, September (Baker). Golden, July (Thorell).

**Philodromus rufus** Walek.

Fort Collins, sweeping low herbage, May, July.

LYCOSIDÆ.

**Lycosa grandis** Bks.

One male, Fort Collins (Baker).

**Lycosa carolinensis** Hentz.

One male, Fort Collins (Baker).

**Lycosa coloradensis** Bks.

Fort Collins (Baker), (Mr. F. de Haahn).

**Lycosa scalaris** Thor.

Fort Collins, under stones; West Cliff (Cockerell).

**Lycosa modesta** Thor.

Fort Collins, under stones; West Cliff (Cockerell).

**Lycosa brunneiventris** Bks.

Fort Collins, under stones (Baker).

**Lycosa beani** Em.

One male apparently this species, Fort Collins (Baker).

**Pirata insularis** Em.

Fort Collins, among dead leaves, under stones, November.

**Pardosa concinna** Thor.

Fort Collins, low herbage, May; under stones, November, West Cliff (Cockerell). Kelso's Cabin (Thorell).

**Pardosa sternalis** Thor.

*P. luteola* Em.

Fort Collins, sweeping, May. Boulder, Manitou (Thorell).

**Pardosa pallida** Em.

Fort Collins, on lawn (Mrs. Baker).

**Pardosa coloradenesis** Bks.

West Cliff (Cockerell).

**Pardosa uncata** Thor.

Fort Collins, November. Georgetown (9,500 ft.), Mount Gray (Thorell).

**Pardosa dorsalis** Bks.

West Cliff (Cockerell).



**Pardosa grœnlandica** Thor.*P. iracunda* Thor. and *P. sinistra* Thor.*P. albomaculata* Em.

Long's Peak, July (Gillette); Cameron Pass, July (Baker);  
Pike's Peak, Kelso's Cabin, Gray's Peak and Arapahoe Pass, July  
(Thorell).

**Pardosa tristis** Thor.*P. indagatrix* Thor.

Fort Collins, Denver, Manitou (Thorell). Emerton considers  
these as synonyms of *P. grœnlandica*. Although the differences  
are slight, I keep it separate, as the *P. grœnlandica* is found above  
timber line and *P. tristis* quite low down.

**Pardosa atra** Bks.

West Cliff (Cockerell).

**Pardosa impavida** Thor.

Manitou, July (Thorell). Fort Collins (Mrs. Baker).

**Trochosa cinerea** Fabr.

Fort Collins (Baker), West Cliff (Cockerell).

**Trochosa parva** Bks.

Fort Collins, under stones, November, December.

**Pisaura undata** Hentz.

Fort Collins, one specimen (Gillette).

**Dolomedes scriptus** Hentz.

One specimen, Fort Collins (Baker).

## OXYOPIDÆ.

**Oxyopes compacta** Bks.

Dixon's Cañon, May (Baker). Fort Collins (Mrs Baker).

## ATTIDÆ.

**Phidippus audax** Hentz.

Fort Collins, sweeping low herbage.

**Phidippus insolens** Thor.

Dixon's Cañon, September (Gillette). Denver, July (Thorell).

**Philæus militaris** Hentz.

Fort Collins, sweeping, May; Estes Park, July. Common.

**Dendryphantes octavus** Hentz.

Fort Collins, Steamboat Springs, sweeping, May, June, July.  
Common.

**Dendryphantes** sp. (?)

One immature specimen differs in markings from any form  
known to me; there are three reddish stripes on the abdomen.

***Astia vittata* Hentz.**

One male, Fort Collins (Gillette).

***Icius vitis* Ckll (*Dendryphantes*).**

Fort Collins, sweeping, May, September.

***Icius monticola* Bks.**

One male, Moon's Ranch, near Livermore (Baker).

***Icius similis* Bks.**

Fort Collins, sweeping, May ; Four-mile Hill, July.

***Attus monadnock* Em.**

West Cliff (Cockerell).

***Attus palustris* Peck.**

Fort Collins, on lawn (Mrs. Baker).

***Habrocestum decorum* Blk.**

Fort Collins (Baker).

***Habrocestum cœcatum* Htz.**

Fort Collins, sweeping, May.

***Habrocestum clypeatum* Bks.**

One male, Dixon's Cañon, May (Baker).

***Habrocestum* sp.?**

One young specimen, Elk River, July (Baker.) It may be *H. montanum* Em.

***Ergane borealis* Blk.**

*Hasarius hoyi* Peck.

Fort Collins sweeping, May.

***Synageles picata* Htz.**

One specimen, Fort Collins, sweeping, May (Baker).

PHALANGIDA.

***Sclerobunus robustus* Pack.**

West Cliff (Cockerell).

***Taracus packardi* Simon.**

Described from the State ; unknown to me.

***Trachyrhinus favosus* Wood.**

Fort Collins, under stones and among dead leaves. Common.

***Homolophus biceps* Thor.**

West Cliff, Fort Collins, Trinidad, Four-mile Hill. Common.

PSEUDOSCORPIONIDA.

***Chelifer cancroides* Linn.**

Fort Collins, one specimen (Baker).

**Chelanops grossus** Bks.

Fort Collins (Baker).

**Chelanops pallipes** Bks.

One specimen, Hotchkiss (J. H. Cowan).

SCORPIONIDA.

**Centrurus carolinianus** Beauv.

Trinidad (Gillette).

**Vejovis** sp. (?)

One specimen, Dolores (Gillette).

SOLPUGIDA.

**Datames sulfureus** Simon.

Recorded by Simon from the State.

**Datames pallipes** Say.

Two specimens, Fort Collins, under a board, July (Gillette).

ACARINA.

TROMBIDIDÆ.

**Trombidium sericeum** Say.

Fort Collins, among dead leaves, November (Gillette)

ERYTHLEIDÆ.

**Actineda agilis** Bks.

Fort Collins, sweeping and among leaves.

RHYNCOLOPHIDÆ.

**Rhyncolophus longipes** Bks.

One specimen, Fort Collins (Baker).

**Rhyncolophus maculatus** Bks.

Fort Collins (Baker).

**Rhyncolophus parvus** Bks.

Fort Collins, November (Gillette).

**Rhyncolophus robustus** nov. sp.

Length 3 mm. Alcoholic specimens pale yellowish, head blackish. Body oblong, twice as long as broad, slightly constricted in middle, clothed with short stiff hairs; dorsal groove reaching considerably beyond eyes, it is enlarged a short distance before the tip; last joint of leg I. two-thirds as long as the penultimate, leg IV. a little longer than body, its last joint less than one-third as long as penultimate; palpi short, third joint twice as long as broad, fourth much shorter ending in a stout claw, thumb large swollen, much surpassing the claw.

Quite common, Fort Collins (Gillette).

TETRANYCHIDÆ.

**Bryobia pratensis** Garman.

Recorded by Mr. Baker from the State.

BDELLIDÆ.

**Bdella peregrina** Bks.

Fort Collins (Baker).

**Eupalpus echinatus** Bks.

Fort Collins, attached to a species of *Ceresa* (Gillette).

EUPODIDÆ.

**Rhagidia pallida** Bks.

Fort Collins, among dead leaves, November (Gillette).

**Linopodes antennæpes** Bks.

Fort Collins, among dead leaves, November (Gillette).

ORIBATIDÆ.

**Belba australis** Bks.

Two specimens, Fort Collins, among dead leaves, November (Gillette).

GAMASIDÆ.

**Laelaps** sp.

Fort Collins (Gillette).

**Iphis** sp.

Fort Collins (Gillette).

DERMANYSSIDÆ.

**Dermanyssus gallinæ** Redi.

Fort Collins, from chickens (A. Cameron).

IXODIDÆ.

**Dermacentor americanus** Linn.

*Ixodes variabilis* Say.

Fort Collins, sweeping and from neck of man.

**Rhipicephalus** sp.

One specimen from Kittdeer, Fort Collins (R. C. Stephenson).

TYROGLYPHIDÆ.

**Homopus** (?) sp.(?)

Fort Collins, on wood-mouse (Gillette).

**ADDENDA.**

In the preceding article I omitted to state that those species seen by me and not followed by the collector's name, were received from both Prof. Gillette and Mr. Baker.

I have since received some additional material from Mr. and Mrs. Baker, containing a few species not in the collections which they had previously sent me. Mr. Baker sends a male specimen of *Gnaphosa sericata* Koch (*bicolor* Htz.), collected in May at Ft. Collins. Mrs. Baker collected a specimen of *Cicurina robusta* Simon, on the lawn in May. It was described by Simon from the State, but was previously unknown to me. Mr. Baker also sends a new species of *Philæus* (*P. monticola*), which will be described elsewhere.

In Mr. Cockerell's collection from West Cliff, I accidentally overlooked an attid; *Habrocestum hirsutum*; it was previously known only from Oregon.

## XV.—*Coleopterological Notices.*

### VI.

BY THOS. L. CASEY.

Read May 20, 1895.

The fact that two entire families of North American Coleoptera, although treated monographically in the present work, are composed principally of species whose names now appear for the first time in the annals of scientific literature, must be regretfully regarded as proving the comparatively slight amount of interest evinced in this country for the systematic study of entomology. The study of nature in any sphere is ennobling and broadening to the mind, whether it concerns elementary matter or the physical forces which control the universe, the infusoria or the mammals, the bacteria or those great trees which excite the admiration of the most apathetic of us; but, as we human beings are primarily and essentially a social animal, it is evident that in a general sense the opinion of the people at large must have some weight in fashioning the tastes and predilections, even of those in whom the thirst for disinterested research is especially developed. We can account in this way for the exceedingly small proportion of scientific men who regard the study of morphological entomology as worthy of very serious consideration, although it can scarcely be disputed that in the Insecta occur the most wonderful structures to be found in the entire domain of nature, the most singular adaptations, and the most prolific sources of data to be ultimately utilized in attacking some of the apparently inscrutable problems of biological evolution.

Perhaps the day may arrive some centuries hence, when the world shall have become more widely and more homogeneously educated, when systematic workers in the field of entomology can count themselves among the candidates for honors and distinctions, similar to those now bestowed by popular favor upon him who discovers out in space a tiny point revolving about a dash of light almost equally minute, or who, by mathematical

logic deduces the laws of planetary motion, or who, by patient and careful weighing discovers a hitherto unknown constituent of our atmosphere. These fields of scientific enquiry are all parts of one grand cosmos, and I cannot conceive one of them to be more soul-inspiring than another; they are all equally wonderful, equally beautiful, and equally beyond the ken of finite intellect.

NORFOLK, VA., May 18, 1895.

## STAPHYLINIDÆ.

### CONOSOMA Kraatz.

This genus is represented in America by numerous species, which, because of their comparatively constant and monotonous facies, have gained the reputation of being a difficult lot to deal with systematically; but this is by no means the case in reality. There are several sclerites which are sufficiently diversified to afford most satisfactory taxonomic elements, and in fact the species can be separated into two almost equal divisions, based upon radically different types of epipleural structure which can be recognized upon mere cursory examination. The extent of development of the long erect tactile setæ of the abdomen, antennal structure, sculpture of the elytra and ventral characters of the male can also be employed advantageously in classification, as these all differ in a marked and sufficiently constant degree among the various species; the difference in elytral sculpture between *knoxii*, *bipustulata* and *parvula*, for example, is very pronounced. In some cases I have resorted to peculiarities of coloration for the principal differential character of the species.

In the following table I have been compelled to add a number of new species to those already known, and to correct some very inaccurate and misleading synonymy which has been allowed to stand in our recent lists:—

- I. Epipleuræ broader, subhorizontal, pubescent, impressed toward base, but with the outer margin only descending slightly below the inner.  
Pronotum abruptly pale in color in basal half, the elytra pale but blackish laterally and toward apex.....1. **knoxii**
- Pronotum unicolorous or only feebly and suffusedly pale toward base.  
Elytra each with a large, obliquely oval pale spot at base...2. **littorea**
- Elytra unicolorous or suffusedly pale at base throughout the width.  
Body blackish in color, the elytra rufous at base.....3. **opica**

Body blackish throughout, occasionally with the elytra and abdomen slightly rufescent.

Abdominal setæ short sparse and inconspicuous toward base.

Fifth ventral of the male sinuate at apex, the sixth with a deep rounded median sinuation.....4. **imbricata**

Fifth ventral unmodified at apex, the sixth with a broad and shallow sinuation four or five times as wide as deep.

#### 5. **limuloides**

Abdominal setæ long and bristling throughout the length.

#### 6. **velocipes**

Body more or less pale in color throughout.

Species of the Pacific coast .....7. **castanea**

Species of the Atlantic coast.

Outer edge of the epipleuræ not lower than the inner, the epipleural surface evenly and symmetrically excavated through a large part of its extent.....8. **virginiae**

Outer edge descending slightly below the inner toward base, the excavation near the inner edge ; much smaller species.

#### 9. **macer**

**II.** Epipleuræ narrow, glabrous, becoming subvertical toward base, the outer margin generally descending very far below the inner.

Elytra without marginal setæ.

Black, each elytron with a median red spot at the base.

Large species. Europe and the Pacific coast.....10. **bipustulata**

Small species. Atlantic regions.....11. **basalis**

Black or paler, the elytra unicolorous or suffusedly pale at the base throughout the width.

Species large or moderate in size, always distinctly more than 1 mm. in width.

Epipleuræ extending to the elytral apex.....12. **occulta**

Epipleuræ not attaining the elytral apex.

Epistoma fully one-half wider than long ; antennæ slender, with the eleventh joint twice as long as wide—♀ .....13. **crassa**

Epistoma but slightly wider than long ; antennæ shorter and less slender, the eleventh joint much shorter ; body very much smaller—♀ .....14. **versicolor**

Species small, always less than 1 mm. in width.

Elytra with rather finely imbricate sculpture.

Elytra longer than the prothorax.....15. **debilis**

Elytra equal in length to the prothorax ; body less oval and more rectilinear at the sides .....16. **subtilis**

Elytra short and transverse, with very coarsely imbricate sculpture.

#### 17. **parvula**

Elytra with a single series of five or six long black setæ along the lateral edge ; body pale, the elytra feebly nubilata with a blackish design.

#### 18. **scripta**



Whenever possible the descriptions which follow are drawn from the male.

The measurements of length refer to the head and body as far as the extremity of the elytra, the abdomen being wholly excluded.

1. **C. knoxi** Lec.—Proc. Acad. Nat. Sci., Phila., 1866, p. 374; Horn: Trans. Am. Ent. Soc., VI., 1877, p. 110.

Moderately broad, testaceous, the head and apical half of the pronotum, elytra externally and toward apex and abdomen in about apical half, black; antennæ blackish but testaceous toward apex and base. Head nearly one-half as wide as the prothorax, minutely punctulate, extremely minutely and feebly substrigilate, the antennæ long, feebly incrassate, the tenth joint in the male but slightly longer than wide, the eleventh one-half longer than wide and acutely and symmetrically pointed. Prothorax three-fifths wider than long, the apex about three-fifths as wide as the base, minutely, very closely and rather distinctly punctulate, the surface extremely minutely and transversely substrigilate. Elytra nearly as long as wide, only slightly narrowed from the base, with the sides evenly and feebly arcuate, slightly narrower than the prothorax, the external apical angles right and but little rounded; apex very feebly, triangularly emarginate; disk rather depressed and finely, excessively densely punctulate, extremely minutely and densely pubescent. Abdomen rapidly conical, the black setæ short and inconspicuous toward base. Length 2.25 mm.; width 1.25 mm.

Pennsylvania to Wisconsin (Bayfield, Lake Superior). The male has a large triangular emargination at the apex of the sixth ventral segment, the angle of which is rather broadly rounded. In this distinct species the elytral sculpture and vestiture are more minute and dense than in any other known to me.

2. **C. littorea** Linn.—Faun. Suec., 852 (Staphylinus); Er.: Gen. Staph., p. 219 (Conurus); Horn: Tr. Am. Ent. Soc., VI., p. 109.

Almost similar in form and size to *knoxii*, blackish throughout, the pronotum near the sides and a large somewhat obliquely oval spot at the middle of the base of each elytron testaceous; apices of the ventral segments slightly pale. Length 2.4 mm.; width 1.35 mm.

Europe and Massachusetts. The sixth ventral of the male has a very large triangular emargination nearly as in *knoxii*, but with

the angle less rounded, and the elytral sculpture is extremely finely and closely imbricato-punctulate, almost as densely as in *knoxi*. As in that species, the epipleuræ are very wide, nearly flat, subhorizontal, densely pubescent and punctulate throughout and broadly, feebly impressed in the middle toward base. I am of the opinion that the few examples of this species thus far taken in the United States are mere sporadic importations.

3. **C. opica** Say—Trans. Am. Phil. Soc., IV., p. 467 (Tachyporus); Horn; Trans. Am. Ent. Soc., VI., p. 112 (Conosoma); *cinctula* Er.: Gen. Staph., p. 226 (Conurus); *corticola* Csy.: Cont. Col. N. A. II., p. 146 (Conurus).

Oval, strongly convex, rather shining, blackish, the basal margin of the pronotum very narrowly and the base of the elytra broadly, rufescent; antennæ infusate, pale toward base, the eleventh joint yellowish; legs pale. Head finely, sparsely punctulate, a little less than one-half as wide as the prothorax, the antennæ rather short and incrassate, the tenth joint distinctly transverse; last joint of the maxillary palpi slender, oblique and subulate, but nearly as long as the third. Prothorax two-thirds wider than long, the apex three-fifths as wide as the base, the basal angles but slightly prominent posteriorly and obtusely rounded; disk not punctate except the minute scars left by fallen hairs. Scutellum large, the apex not at all rounded. Elytra not quite as long as wide, distinctly longer than the prothorax, evenly and moderately narrowed from the base, the sculpture rather coarsely but feebly imbricate. Abdomen gradually and evenly tapering throughout the length, the erect bristles very short and inconspicuous except at tip. Length 1.7 mm.; width 1.05 mm.

New York to Virginia and westward. The male has the sixth ventral broadly and triangularly emarginate at tip, the angle rounded. The epipleuræ are horizontal, wide, coarsely pubescent throughout, and broadly and almost symmetrically excavated toward base.

4. **C. imbricata** Csy.—Cont. Deser. and Syst. Col. N. A., II., p. 143 (Conurus); *pubescens* Horn nec Payk.: Trans. Am. Ent. Soc., VI., p. 111; *adepts* Zimm. i. litt.

Suboval, rather stout, very strongly convex, blackish throughout, the elytra generally more or less reddish; legs rufous; antennæ blackish except at apex and toward base; punctures of the

head and pronotum exceedingly minute and occupied almost entirely by the base of the hairs. Head one-half as wide as the prothorax, the antennæ rather long, gradually and evenly incrassate through the last six or seven joints, the penultimate slightly wider than long. Prothorax nearly one-half wider than long, the basal angles rather abruptly prominent posteriorly, right and not distinctly rounded. Elytra not quite as long as wide, somewhat distinctly longer than the prothorax, perceptibly narrowed from the base, with the sides very feebly but evenly arcuate, the disk strongly convex, perfectly even in coloration, somewhat coarsely and feebly imbricate and minutely, very densely pubescent. Abdomen quite evenly tapering from base to tip, the erect setæ short and inconspicuous except at the apex. Length 2.0–2.25 mm.; width 1.15–1.3 mm.

New York, New Jersey and Pennsylvania. The male has a feeble rounded median sinuation at the apex of the fifth ventral, the sixth having a deep rounded sinuation at the middle, about three times as wide as deep and with the external angles very broadly arcuate. The epipleuræ are wide, punctulate and pubescent throughout, subhorizontal and broadly impressed in about basal half.

This species is allied to the European *pubescens*, but is more convex, with more gradually incrassate antennæ, and differs also in coloration and decidedly in sculpture. In *pubescens* Payk., of which I have before me a series carefully determined by Mr. Reitter, the elytra are smaller and more depressed, and are generally rufous with the suture and flanks blackish; the antennæ are much more rapidly and strongly incrassate through the outer five joints, and the penultimate joints are fully as long as wide; the sinuation of the fifth ventral is much wider and the rounded notch of the sixth narrower, not more than twice as wide as deep, with the external angles much less broadly rounded. In the European species the elytral sculpture is very much finer, denser and less distinctly imbricate, this being noticeable in all the numerous specimens compared, even under the low powers of the hand lens.

The recently published lists of Coleoptera common to Europe and America have in several cases been carried much too far, and numerous instances occur, especially in the Staphylinidæ, where species closely allied by reason of community of descent have been regarded as identical; in some cases the species which have

been thought to be identical are not even particularly closely related to each other. These mistakes principally refer to the fauna of eastern North America, the proportion of common forms of the west coast being much greater. In fact, if we omit the well known cosmopolitan species and those which have been sporadically and locally introduced, the fauna of eastern America includes but a very small actual number of species identical with their homologues of Europe, and there is no good reason why the term "Nearctic" should not be employed for this region, in contradistinction to "Palæarctic," which includes Europe, northern Asia and the west coast of North America. The large number of identical genera and closely allied species in the Nearctic and Palæarctic faunas shows plainly that they have a common origin, but there can be no doubt that they are now sufficiently differentiated to warrant a continuation of the distinctive appellations.

5. **C. limuloides** n. sp.—Suboval, strongly convex, moderately shining, blackish throughout, the apices of the ventral segments slightly paler; legs pale testaceous, the posterior darker; antennæ infusate toward the middle; pubescence moderately fine, dense and decumbent, dark in color; punctures of the head and pronotum extremely fine, occupied by the base of the hairs; those of the elytra not distinct. *Head* barely one-half as wide as the prothorax, the epistoma only moderately transverse; antennæ extending slightly beyond the base of the prothorax, very stout and gradually incrassate, the penultimate joints rather strongly transverse. *Prothorax* rather elongate, not more than two-fifths wider than long, the apex about three-fifths as wide as the base; sides evenly arcuate; basal angles moderately and not very abruptly prominent posteriorly, slightly more than right and not much rounded. Scutellum large, triangular, slightly wider than long, with the sides very feebly arcuate and the apex scarcely at all blunt. *Elytra* not quite as long as wide and but slightly longer than the prothorax, the sides scarcely visibly convergent from base to apex and extremely feebly but evenly arcuate; apex very feebly angulato-emarginate; disk, rather coarsely imbricate, the imbrications feebly reticulate. *Abdomen* gradually tapering, the setæ very short, sparse and inconspicuous except at apex. Length 1.8 mm.; width 1.2 mm.

#### Iowa.

Readily distinguishable from the preceding, which it strongly resembles in habitus, by the sexual characters of the male, the fifth ventral being completely unmodified and the sixth having a broad shallow apical sinuation, rounded at the bottom and four or five times as wide as deep; it also differs in its shorter antennæ, with the outer joints much more transverse. The epipleuræ are nearly flat throughout, being feebly impressed only near the base. Three specimens.

6. **C. velocipes** n. sp.—Moderately stout, strongly convex, feebly shining, blackish, the basal margins of the pronotum and elytra unevenly and feebly suffused with a paler reddish tint; abdomen paler, red-brown throughout; legs and antennæ rufo-testaceous, the latter paler and more yellowish toward base and at the eleventh joint; pubescence very fine, dense and plumbeo-cinereous throughout, the punctures minute and scarcely visible. *Head* small, distinctly less than one-half as wide as the prothorax, the epistoma paler and with more distinct punctulation and reticulation; antennæ rather long, evenly and gradually incrassate through the last six or seven joints; the ninth scarcely as long as wide, the tenth perceptibly wider than long, eleventh rather short, somewhat rapidly, obliquely and acutely pointed at apex. *Prothorax* nearly three-fifths wider than long, the apex but slightly more than one-half as wide as the base, the sides evenly and strongly arcuate becoming parallel toward base, the basal angles gradually and only moderately prominent posteriorly and distinctly rounded. *Elytra* nearly one-fourth wider than long, not at all longer than the prothorax, the sides distinctly convergent but only very slightly arcuate from base to apex; disk convex, moderately finely imbricate. *Abdomen* very evenly and gradually tapering from base to apex, the erect black setæ long and distinct at the sides throughout, but, as usual, less numerous toward base. Length 2.0 mm.; width 1.4 mm.

New York (near the city); New Jersey; Virginia (Fredericksburg).

This distinct species may be readily known by the ventral sexual characters of the male, the long black and bristling setæ being very numerous throughout, except broadly along the median line where the ordinary short pale pubescence becomes longer, more erect and conspicuous. The sixth ventral has a triangular nick in median third at apex, the notch nearly three times as wide as deep and with the angle not rounded, the apex of the fifth segment arcuately sinuate in the middle. The epipleuræ are wide and become gradually nearly glabrous toward base. This species may be distinguished from *imbricata* by its shorter elytra and long black bristles toward the base of the abdomen.

7. **C. castanea** Horn—Trans. Am. Ent. Soc., VI., p. 111; *acutangulum* Fvl., i. litt.

Rather stout, strongly convex, pale brownish-testaceous in color throughout, minutely and densely pubescent, the punctures scarcely visible. Length 1.7–1.9 mm.; width 1.1–1.3 mm.

Coast regions of California from Humboldt to Los Angeles; I obtained three specimens also at Lake Tahoe, which represent a slightly smaller and narrower variety. The male has a rounded

sinuation at the apex of the sixth ventral, occupying about median third and about three times as wide as deep, and the apical margin of the fifth segment is very feebly sinuate in the middle. The epipleuræ are wide, pubescent throughout and broadly, feebly impressed toward base. A female specimen, taken near Monterey Bay, is blackish throughout but does not seem to differ materially otherwise.

8. **C. virginiae** n. sp.—Stout, strongly convex, feebly shining, the pubescence fine, very dense and plumbeo-cinereous throughout, the punctures scarcely visible; body pale brownish-testaceous in color, the legs concolorous; antennæ brown, paler and diaphanous toward base, the eleventh joint also pale. *Head* small, scarcely two-fifths as wide as the prothorax, the antennæ rather long, very evenly and gradually incrassate through the seven outer joints, the ninth slightly elongate, the tenth a little wider than long, eleventh scarcely one-half longer than wide, almost symmetrically and rapidly pointed at apex. *Prothorax* one-half wider than long, strongly convex, the sides strongly and evenly arcuate, becoming parallel toward base; the apex but slightly more than one-half as wide as the base, the basal angles gradually and strongly prominent posteriorly, right and slightly blunt. *Elytra* a little narrower and but very slightly longer than the prothorax, not quite as long as wide, the sides distinctly convergent and broadly arcuate from base to apex, the latter broadly and triangularly emarginate; disk somewhat coarsely but feebly imbricato-punctulate. *Abdomen* gradually tapering from the base, the black setæ rather long and conspicuous even toward base. Length 2.1 mm.; width 1.4 mm.

Virginia (Norfolk).

In the male the sixth ventral has a triangular notch occupying about median third of the apex and about twice as wide as deep, with the angle scarcely at all rounded and the sides nearly straight, and the fifth segment is feebly sinuate in the middle of the apical margin. The epipleuræ are moderately wide, deeply hollowed in more than basal half, pubescent but becoming gradually glabrous near the base. A single specimen.

9. **C. macer** n. sp.—Rather narrow, strongly convex, feebly shining, pale brownish-testaceous throughout, the legs and antennæ concolorous, the latter more flavate at apex and toward base as usual; pubescence very dense, rather dark in color. *Head* nearly one-half as wide as the prothorax, the antennæ moderately long, evenly but rather rapidly incrassate through the five or six outer joints, the seventh elongate, the ninth and tenth somewhat wider than long, eleventh oval, stout and very obliquely pointed at apex. *Prothorax* fully one-half wider than long, the apex two-thirds as wide as the base; sides evenly and strongly arcuate; basal angles gradually and strongly prominent posteriorly, right and only slightly blunt. *Elytra* short and transverse, nearly

one-half wider than long and distinctly shorter than the prothorax; sides evidently convergent from the base but only very feebly arcuate, the angulate emargination of the apex exceedingly feeble; disk convex, evenly and not very finely imbricate, the imbrications pronounced and not reticulate. *Abdomen* rapidly and very evenly tapering throughout, the erect black setæ not evident toward base. Length 1.4–1.6 mm.; width 1.0–1.2 mm.

South Carolina; Virginia (Norfolk).

The male above described has the tip of the sixth ventral emarginate throughout the width, the notch broadly triangular, and about three times as wide as deep, with the sides feebly arcuate and the angle narrowly rounded; the fifth ventral is completely unmodified at apex and without trace of median sinuation. Five specimens.

10. **C. bipustulata** Grav.—Microp., p. 132 (Tachyporus); *bisignata* Horn: Tr. Am. Ent. Soc., VI., p. 110.

Oval, convex, shining, black, each elytron with a large transverse and posteriorly sinuate spot of red at the middle of the base; legs piceous-brown; antennæ infusate except toward base and at the apex; pubescence very short, dark in color, rather dense. Length 2.5 mm.; width 1.6 mm.

Europe, eastward through Asia and along the western coast of North America to the mountains of California. This species is remarkable in having no trace of imbricate sculpture on the elytra and in fact this sculpture, which is universal in the American species of the preceding group, is frequently subobsolete in this section of the genus; in the present species the surface is finely punctulate and minutely and transversely strigilato-reticulate. The epipleuræ become vertical externally toward base and are glabrous, with the exception of a few hairs along the inner marginal bead; they do not quite attain the elytral apex and the external angles of the elytra are rounded. The basal angles of the prothorax are only feebly produced posteriorly and are rounded.

11. **C. basalis** Erichs.—Gen. Staph., p. 225 (Conurus); Horn: Tr. Am. Ent. Soc., VI. p. 111; *pulicaria* Sachse: Stett. Zeitsch., 1852, p. 120; *setifer* Csy.: Cont. Col. N. A., II., p. 147 (Conurus).

Rather narrowly oval, strongly convex, shining, blackish, each elytron with a large and somewhat indefinite transverse spot of red at the middle of the base; under surface rufescent, the legs pale brown; body clothed throughout with rather dense plumbeo-

cinereous pubescence. Head small, two-fifths as wide as the prothorax, the antennæ rather long and slender, gradually and very feebly incrassate, the penultimate joint longer than wide. Prothorax somewhat longer than usual, scarcely one-half wider than long, rapidly subconical throughout, the sides arcuate, not becoming parallel at the base, the basal angles rather strongly prominent posteriorly but distinctly rounded. Elytra slightly wider than long, equal in length to the prothorax; distinctly narrowed from the base, the imbrications rather large but feeble, and subtransversely and finely reticulate. Abdomen very evenly tapering throughout, the erect black setæ long and conspicuous to the base. Length 1.5 mm.; width 1.05 mm.

New York to Iowa and Texas. A small and widely distributed species, varying but little in the large series before me. The male has a large and broadly rounded emargination occupying the entire apex of the sixth ventral segment, the fifth being completely unmodified at the apical margin. The epipleuræ are narrow and do not quite attain the rounded apical angles; they became vertical toward base externally and are practically glabrous throughout.

In assigning *setifer* to *opica* Say, as a synonym, Dr. Horn entirely neglected to observe the long bristling setæ throughout the length of the abdomen, which would have shown him its true position at once, irrespective of the radically different form of the epipleuræ.

12. **C. occulta** Csy.—Cont. Descr. and Syst. Col. N. A., II., p. 145. (Conurus).

Oblong-oval, convex, rather shining, black, the basal margin of the pronotum very narrowly and the apices of the abdominal segments paler; base of the elytra broadly and indefinitely rufescent, less broadly so toward the scutellum; under surface rufopiceous, the legs red-brown; pubescence not very dense and unusually long, dark fulvo-cinereous in color and conspicuous. Head somewhat small, much less than one-half as wide as the prothorax, the antennæ gradually incrassate. Prothorax rather short and wide, fully three-fifths wider than long, the sides strongly arcuate, very convergent anteriorly but becoming parallel a long distance from the base; basal angles gradually and only feebly prominent posteriorly and broadly rounded. Elytra



not quite as long as wide, much longer than the prothorax, distinctly narrowed behind from the base; external apical angles right and but slightly rounded; disk coarsely, feebly and imperfectly imbricate and finely, subtransversely strigilato-reticulate. Abdomen with the erect black setae only moderate in length but distinct to the base. Length 1.8 mm.; width 1.2 mm.

District of Columbia and Massachusetts. This is an isolated species, in no way closely related to *basalis*, differing in its larger size, more transverse and much less conical prothorax, and in its longer and sparser pubescence. It differs most radically, however, in the male sexual characters, the fifth ventral in that sex being broadly sinuate in more than median two-thirds; the sinuation rounded and about ten times as wide as deep, the sixth segment having a deep rounded sinuation in about median third. The epipleurae are rather narrow but extend to the elytral apex, gradually vertical externally towards base, glabrous but with a few sparse hairs posteriorly. The two specimens from the last named locality, since received, do not differ in any way from the original female type from the District of Columbia.

13. **C. crassa** Grav.—Microp. p. 190 (Tachyporus); Er.: Gen. Staph., p. 222. (Conurus); Horn: Tr. Am. Ent. Soc., VI., p. 110; *mesta* Say, Trans. Am. Phil. Soc., IV. p. 466 (Tachyporus).

Stout, oval, strongly convex, blackish, the base of the elytra and basal margin of the pronotum suffusedly rufescent; abdominal segments slightly paler at apex, especially the fifth; base of the sixth also largely rufous; legs dark rufous; last joint of the antennae yellow; pubescence rather coarse and moderately dense. Length 2.3–2.7 mm.; width 1.5–1.8 mm.

New York and North Carolina (Asheville) to Wisconsin (Bayfield). This is a common and widely distributed species of large size, being much the largest American representative of the genus. The male has the fifth ventral perfectly simple at apex, the sixth having a very large and deep, almost circularly rounded emargination, and there are numerous long black setae on the abdomen beneath and at the sides as far as the base. The epipleurae are very narrow, attenuate behind, not attaining the elytral apex, glabrous and polished throughout and becoming strongly vertical toward base. The elytral sculpture is not imbricate, each of the minute punctures having two short divergent lines extending posteriorly, and the scutellum is parabolic and rounded at tip.

On attentive observation the structural differences among the species of *Conosoma*, as for example between *crassa* and *knosi*, are, as before remarked, very radical indeed, in spite of the general constancy of external form.

14. **C. versicolor** Csy.—Cont. Descr. and Syst. Col. N. A. II., p. 142 (*Conurus*).

Moderately stout, oval, strongly convex, pale piceo-testaceous, the elytra except toward base and at the apical margin blackish; abdomen blackish, paler at apex; integuments rather shining; pubescence somewhat dense and fine, dark in color and not very conspicuous. Head small, much less than one-half as wide as the prothorax, the latter about one-half wider than long, with the basal angles but feebly and gradually prominent posteriorly and rather broadly rounded. Elytra much shorter than wide, equal in length to the prothorax, distinctly narrowed behind from the base, the sides evidently arcuate; disk with somewhat sparse punctures having lineiform appendages as in *crassa*. Abdominal setæ long, black and conspicuous to the base. Length 1.9 mm.; width 1.3 mm.

Pennsylvania (near Philadelphia). This species is allied to *crassa*, but is evidently distinct. It is very much smaller than any example of a very large series of *crassa* which I have before me, and differs in antennal structure to a marked and perfectly decisive degree, this organ being much more rapidly and strongly incrassate, the tenth joint not or scarcely longer than wide and the eleventh very much shorter than in *crassa*, where its elongate form constitutes one of the principal distinctive features of the species in both sexes. It differs, besides, in the much narrower epistoma. It is still represented by the unique female type.

In the original description of both this species and *occulta*, I have obviously underestimated the width of the prothorax in terms of its length, the deception in relative proportion when measured by the eye not having occurred to me at that time.

15. **C. debilis** n. sp.—Oval, strongly convex and slightly shining, dark castaneous throughout, the legs and antennæ paler; pubescence moderately short and dense, rather dark in color; punctures scarcely visible. Head distinctly less than one-half as wide as the prothorax, the subulate fourth joint of the maxillary palpi densely pubescent; antennæ rather short, about as long as the head and prothorax, very gradually and only moderately incrassate, the ninth joint slightly elongate, tenth as long as wide, the eleventh scarcely one-

half longer than wide, somewhat obliquely pointed, basal joints each with a few very long erect black setæ near the apex. *Prothorax* one-half wider than long, the sides evenly and strongly arcuate, becoming parallel at the base; apex three-fifths as wide as the base, the basal angles gradually and rather strongly prominent posteriorly but quite distinctly rounded. Scutellum triangular with the sides straight and the apex only slightly blunt. *Elytra* not quite as long as wide, the suture distinctly longer than the prothorax, evidently narrowed behind from the base, with the sides evenly and feebly arcuate; apex broadly, angularly emarginate, the outer apical angles rather broadly rounded; disk somewhat finely imbricate, the imbrications relatively very coarsely reticulate. *Abdomen* gradually tapering, bristling at the sides with long erect black setæ throughout the length. Length 1.25–1.35 mm.; width 0.85 mm.

North Carolina (Asheville).

The epipleuræ are narrow, becoming obsolete before the rounded apical angles of the elytra and gradually vertical externally toward base; they are glabrous toward base but distinctly pubescent posteriorly. The epistomal suture is rather abruptly and posteriorly sinuate in the middle. The sixth ventral segment of the male has a large deep and triangular emargination, occupying almost the entire apex, scarcely more than one-half wider than deep and with the angle slightly rounded. Numerous specimens are before me differing scarcely at all in size.

16. **C. subtilis** n. sp.—Oblong-oval, strongly convex, feebly shining, pale castaneo-testaceous, with the elytra darker; legs, basal parts and apex of the antennæ paler; pubescence moderately short and dense, dark, the sculpture of the anterior parts very feeble. *Head* fully one-half as wide as the prothorax, the antennæ about extending to the base of the latter, feebly incrassate, with the tenth joint somewhat longer than wide; epistomal suture broadly and posteriorly sinuate almost throughout the width. *Prothorax* fully three-fifths wider than long, the apex three-fifths as wide as the base; sides evenly and strongly arcuate, becoming parallel at the basal angles, which are only moderately prominent posteriorly and distinctly rounded. *Elytra* one-fourth wider than long, the suture equal in length to the prothorax, the sides somewhat convergent and feebly arcuate from the base; external apical angles broadly rounded; disk rather closely imbricate, the imbrications frequently crossed by a fine median line. *Abdomen* with long coarse and bristling black setæ at the sides from apex to base. Length 1.25–1.35 mm.; width 0.8 mm.

Texas (Austin).

The male has a large deep and narrowly parabolic emargination occupying practically the entire apex of the sixth ventral segment, and distinctly less than twice as wide as deep. The epipleuræ are nearly as in *debilis*, but attain the rounded apical angles.

This species is closely allied to *debilis*, but may be distinguished

by its narrower form and decidedly shorter elytra; the first two joints of the antennæ bear long black apical setæ as in *debilis*, but the tip of the abdomen is paler and more acute in *subtilis*.

17. **C. parvula** Horn—Trans. Am. Ent. Soc., VI., p. 111.

Rather narrowly suboval, convex, shining, castaneous, the antennæ somewhat short and incrassate, with the penultimate joint transverse. Prothorax one-half wider than long, the sides arcuate, becoming parallel toward base, the basal angles obliquely and moderately prominent posteriorly and only slightly blunt; disk very coarsely but feebly reticulate. Elytra short, nearly one-half wider than long, narrowed behind, distinctly shorter than the prothorax, with the external angles at apex but little rounded and the disk very coarsely imbricate. Abdomen rapidly tapering, the long black setæ apparently obsolete toward base. Length 1.15 mm.; width 0.7 mm.

North Carolina. This is the smallest species of the genus, and is very distinct from the two preceding in its coarse imbricate sculpture and very short elytra. The epipleuræ are narrow, entire, becoming gradually and moderately deeply vertical externally toward base, and are slightly pubescent posteriorly. The male has a large triangular emargination at the apex of the sixth ventral, the notch more than twice as wide as deep and with the angle narrowly rounded.

18. **C. scripta** Horn—Trans. Am. Ent. Soc., VI., p. 112.

Stout and suboval, very strongly convex, polished, rather sparsely clothed with coarse fulvo-cinereous hairs; body pale brownish-testaceous in color throughout, the pronotum sometimes slightly clouded and the elytra with a blackish nubilate design. Length 1.3–1.5 mm.; width 0.95–1.0 mm.

Rhode Island and New York. This species can be instantly recognized by the long black setæ at the sides of the elytra, the setæ being also more developed on the abdomen at the sides throughout than in any other member of the genus, and there are, besides, four series along the under surface of the abdomen. The epipleuræ are narrow, entire, and only slightly vertical externally toward base, but they differ from the forms prevailing in the preceding section of the genus in being completely glabrous. The elytral punctures are rather sparse and distinct, feebly asperate, each with two short divergent lines,

the sculpture not being imbricate but finely and subtransversely reticulate. The antennæ are unusually short. The two specimens before me are females.

### TROGOPHLEUS Mann.

The species allied to *simplarius* constitute a small group in which the sexual differences in bodily form and habitus become extreme, the male being very much stouter than the female and with the head and prothorax conspicuously larger. The three known to me may be distinguished as follows by the males:—

Eyes large, at much less than their own length from the prothorax; pronotum finely and extremely densely punctate, with a very narrow impunctate median line.

Sides of the prothorax parallel in apical half.....**simplarius** Lec.

Sides of the prothorax convergent from the middle to the apex (*fallax* Csy. ♀)  
**pallidulus** Csy.

Eyes small, at their own length from the base; pronotum finely and sparsely punctate toward the middle, with a broad impunctate median area.

**salicola** n. sp.

The eyes are of about the same size in both sexes, and are therefore larger in proportion to the size of the head in the female than in the male. The inner apical angles of the elytra are narrowly rounded.

**T. salicola**.—Very stout, parallel, rather convex, somewhat shining, deep black throughout; antennæ piceous; legs black, the tibiæ toward base and apex and tarsi paler; pubescence fine, very short and dense but dark in color and only moderately conspicuous. *Head* triangular, as wide as long, impressed within the antennal prominences, finely punctate, sparsely so toward the middle, more densely scabro-reticulate and dull toward the sides; antennæ moderate in length, the second joint as long as the next two; basal joint elongate and contorted. *Prothorax* distinctly wider than the head, two-fifths wider than long, the sides subparallel and feebly arcuate in apical half, strongly convergent from the middle to the base, the latter scarcely more than two-thirds as wide as the apex, which is broadly, evenly arcuate; disk almost even, with scarcely a trace of impressions. *Elytra* distinctly wider than long, two-fifths longer and a little wider than the prothorax, impressed at each side of the suture toward base, finely, closely punctate and somewhat scabriculate. *Abdomen* slightly narrower than the elytra, the sides parallel and feebly arcuate, the surface coarsely and strongly reticulate, finely, not densely punctate and clothed moderately densely with longer and stiffer pubescence. Length 2.8 mm.; width 0.7–0.8 mm.

Utah (Great Salt Lake). Hubbard and Schwarz.

The description, except the measurements, refers to the male, the female being much narrower, the prothorax apparently having but slightly more than one-half the bulk, with the sides more convergent in apical half, the disk more densely punctate and the wide impunctate line better defined.

It is probable that these three species are descended from a common ancestor, inhabiting the regions east of the Rocky Mountains at the time when the Great Salt Lake basin was occupied by a large body of fresh water; as this lake retreated and became more and more saline, *salicola* became correspondingly different from the types represented by *simplarius* and *pallidulus*.

## CUCUJIDÆ.

### MURMIDIINÆ.

Another new genus, very different from any previously known, but apparently assignable to this isolated group of monotypic genera, has recently been discovered, and the genus *Mychocerus*, which was unknown to me in nature when I last referred to the subject (Col. Not. II., p. 321), is now amply represented before me. With this new material, it becomes sufficiently evident that greater weight must be given these interesting structural types than I previously supposed, and, instead of constituting a mere tribe of Colydiinæ, it is probable that they should more properly form a group subequivalent in value to the Colydiidæ, if we view the latter as a family, or to the Colydiinæ, if we consider these a subfamily of the Cucujidæ, as formerly suggested by the writer (Col. Not., II., p. 496). This course is also in harmony with the views of DuVal, who proposed a distinct family for *Murmidius*.

The new genus, referred to above, differs very greatly from all the others in having the fourth joint of the maxillary palpi cylindrical and elongate, fully as wide as the preceding and affixed closely to its apex throughout the width; but the anterior coxæ are small, globular, and have their cavities widely open behind and closed by the mesosternum. It also differs in not having antennal fossæ; but the agreement in many respects is such as to strongly suggest the *Murmidius* group of genera as its nearest allies. The present opportunity may also be taken to correct a serious error, quoted from the books in my previous work, in

regard to *Mychocerus*, the legs in that genus being perfectly free and not retractile.

The principal distinctive features of the *Murmidiinæ* are the very small oval body, the widely separated coxæ, the somewhat elongate basal segment of the abdomen, the ten-jointed antennæ and the small deep coxal cavities, closed behind by the mesosternum, although I have not examined the *Colydiinæ* very thoroughly for the purpose of determining the weight of the latter character as a distinguishing feature.

The four tribes may be briefly characterized as follows:—

Antennal cavities present; last joint of the maxillary palpi slender and aciculate.

The cavities large, shallow and completely on the under surface; labrum triangular, with the apex acutely incised; legs partially retractile; prosternal lobe short .....LAPETHINI

The cavities at the apical angles of the prothorax, visible in front but not from above; labrum short and transverse; legs free; prosternal lobe not concealing the trophi in repose .....MYCHOCERINI

The cavities at the apical angles and wholly visible from above; labrum probably very short and transverse; legs strongly retractile; prosternal lobe large, completely concealing the labrum and mouth parts in repose.

MURMIDIINI

Antennal cavities wanting; last joint of the maxillary palpi elongate and as wide as the preceding; labrum truncate; prosternal lobe short; legs free; anterior coxæ much less widely separated.....EUPSILOBIINI

In *Cerylon* the anterior coxal cavities are completely closed behind by the broad fusion of the propleuræ and intercoxal process, but in *Philothermus* the cavities are open behind. *Philothermus* will therefore form a distinct tribe uniting the *Murmidiinæ* with the *Colydiinæ* through the *Cerylonini*, and might be provisionally attached to the former; in general facies it is strikingly intermediate between *Cerylon* and *Lapethus*. The mentum in *Philothermus* is slightly elongate-oval, with a strong elevation in the form of an acute triangle, and the 11-jointed antennæ have a strong 2-jointed club, the joints being perfectly free.

#### LAPETHINI.

This tribe consists at present of the single genus *Lapethus* (Col. Not., II., p. 317), having the prosternal process rather long, broadly rounded at apex and received, on nearly a common level, in a broad emargination of the mesosternum; prosternum very

widely separating the coxæ and without elevated lines, the anterior lobe short and not concealing the mouth parts. Antennal excavations large and inferior, the antennæ ten-jointed, with the two basal joints large, the third elongate, the club large, oval, compressed and composed of three closely amalgamated joints, as indicated by the pubescent rings. Elytra seriatly punctate, the epipleuræ excavated at base. Met-episterna long, narrow, gradually wider anteriorly and a little more strongly dilated posteriorly, the suture fine, the surface punctate; met-epimera obsolete. Mentum elongate, well developed and strongly carinate along the median line.

Dr. Sharp, in the "Biologia," has regarded some Mexican examples as conspecific with *L. discretus*, but considering the habits of this species, and the fact that members of the true Pacific coast fauna seldom extend into Mexico, it is possible that they may in reality represent an allied but distinct species.

#### MYCHOCERINI.

In this tribe the prosternal lobe is short, broadly truncate and does not conceal the trophi in repose, the mentum very minute, the fourth palpal joint slender and as long as the third; antennæ with the two basal joints large, the club small, solid, scarcely at all compressed, cylindro-ovoidal, obtuse at apex and apparently composed of two completely amalgamated joints, the second forming the more densely pubescent terminal portion. Antennal cavities small, deep, apical and not visible from above. Labrum short and broadly rounded, the epistoma very large, with the suture fine but distinct. Met-episterna very narrow, the suture fine but more visible than in *Murmidi*. Legs completely free, the epipleuræ not at all excavated.

The two genera may be distinguished as follows:—

- Prosternum flat, with two distant and parallel ridges not attaining the apex, the process very short and broad, abutting on a common level with the mesosternum along a transversely rectilinear line; elytra seriatly punctate; body depressed.....**Mychocerus**
- Prosternum transversely convex, with two very fine, distant, elevated and anteriorly diverging lines not quite attaining the apex, the process very short, extending under the advanced and rounded beaded lobe of the mesosternum; elytra without trace of serial punctures, the body much more elongate-oval and convex.....**Botrochus**



In *Botrodon* the fifth and sixth joints of the antennæ are apparently slightly dilated. The type and only species of *Myhocerus* known to me is *M. depressus* Lec., which occurs rarely in the District of Columbia and in Ohio. *Botrodon estriatus* Csy. occurs in Texas. The species recently described from Mexico by Mr. Lewis I have not seen.

#### MURMIDIINI.

The small and possibly cosmopolitan species known under the name *Murmidius ovalis* Beck., differs profoundly from the two preceding genera in a number of structural features, and demands a distinct tribe. The prosternum has two strongly elevated parallel lines not attaining the apex, the anterior lobe being very large, rounded, evenly continuous with the sides of the prothorax and completely concealing all the mouth parts and labrum in repose; intercoxal process short and broad, extending under the broad and advanced mesosternal process. Antennal cavities small, deep, apical, superior and completely visible only from above. Epistoma very large, the suture fine. Legs strongly retractile, the epipleuræ with a deep crural excavation at base and another near the middle. Met-episterna extremely narrow but not concealed by the epipleuræ, the suture very fine and feeble. Elytra seriatly punctate.

I am unable to observe the labrum, trophi or antennæ in the three specimens in my cabinet.

#### EUPSILOBIINI.

The general characters of this tribe are included in the following description of the only genus thus far discovered:—

#### **EUPSILOBIUS** n. gen.

Body almost evenly elliptical and strongly convex, the elytra devoid of punctured series, the scutellum small but distinct, transverse and broadly rounded behind; edges of the pronotum acute and subvertical, with the marginal bead extremely fine and flat, the hypomera beneath broadly concave. Maxillary palpi with the fourth joint long, cylindrical, obtusely pointed, as wide as the third and longer than the three basal joints combined; labial palpi shorter but much stouter, the second joint transverse, the third broad, oval and compressed. Ligula large, broad, cor-

neous, with the palpal foramina large and approximate; remaining mouth parts not clearly visible in the type. Mandibles small. Labrum short, transverse, truncate, the epistoma short and small, with the suture fine. Eyes small and coarsely faceted. Antennæ moderately developed, ten-jointed, the first two moderately large and subequal, the following six small, narrow, compactly joined, the funicle bent at its middle point; club very abrupt, rather large, broad, only slightly longer than wide, oval, strongly compressed, composed of two joints which are apparently free but closely joined, the first transversely lunate and wider than the second, the latter transversely oval, fitting in the hollow of the first; antennæ not received in excavations except the funicle, which may be received in the deep cleft separating the prosternal lobe from the hypomera. Prosternum small, without raised lines, rather narrow between the coxæ, the latter separated by less than their own width, their small and deep cavities closed behind by the mesosternum, the process very short, extending partially under the broad and slightly advanced, rounded and finely beaded mesosternal lobe; apical lobe short, truncate and only partially concealing the mouth parts in repose. Middle coxæ widely, the posterior very remotely separated. Metasternum and first ventral segment with very feeble oblique coxal lines; met-episterna moderately narrow, long and parallel. Abdomen composed of five segments, the last four short and subequal, the first nearly as long as the next three combined; sutures perfectly rectilinear from side to side. Legs short, completely free, the femora stout, oval, partially receiving the tibiæ, the latter short, sublamine and rounded externally; tarsi moderate in length, four-jointed, the three basal joints short; claws small, slender and arcuate; trochanters laminate. Epipleuræ moderate in width, flat, horizontal, gradually and finely attenuate behind, the outer margin descending very slightly below the level of the inner at the base.

The advancement of a rounded and beaded mesosternal lobe is a character peculiarly distinctive of the Phalacridæ, and the general habitus of the body in the present genus also suggests that family, but the resemblance goes no further.

**E. politus** n. sp.—Pale testaceous throughout, strongly shining, the upper surface throughout minutely and sparsely punctate, each puncture bearing a very fine short and decumbent hair. *Head* very strongly transverse, a little more than one-half as wide as the prothorax, received closely within a

transverse emargination of the prothorax ; antennal foveæ extremely remotely separated, very near the eyes and represented from above by small emarginations, the eyes in contact with the advanced apical angles of the prothorax ; antennæ not as long as the width of the head. *Prothorax* short and strongly transverse, about three times as wide as long, the sides strongly convergent and feebly arcuate from the base, the advanced apical angles rounded ; basal angles slightly more than right and not distinctly rounded ; base broadly arcuate. *Elytra* about as long as wide, evenly oval, the sides continuous in curvature with those of the prothorax, the suture about three times as long as the latter and margined with a fine feeble line which becomes obsolete near the base. Hind wings well developed. Length 1.0 mm. ; width 0.6 mm.

Florida (Dry Tortugas). Mr. H. F. Wickham.

It is probable that this species will prove to be widely distributed through the West Indies, and by no means confined to the small sandy islet near Key West. I have before me a single rather ill-conditioned specimen.

#### MELYRIDÆ.

After careful study of the considerable material in my cabinet, I can see no cause to doubt the soundness of Motschulsky's opinion (Bull. Mosc., 1859, p. 388) that the melyrides should constitute a family distinct from the Malachiidæ ; their entire habitus is different, and the most important of the special peculiarities of the Malachiidæ, viz., the extensible vesicles, is completely unknown among them ; their integuments, furthermore, are hard and thick, and resemble those of the Cleridæ rather than the Malachiidæ. The Melyridæ constitute a moderately large family, which is so homogeneous that it is difficult to find many valid characters to define even the genera, and the groups higher than genera are very few in number. The species are exceedingly abundant west of the 100th meridian, and increase in number and variety to the westward, following the same law as the Heteromera, except that they are relatively more abundant perhaps in the true Pacific coast fauna. The family is essentially subarctic, and is very poorly represented south of our Mexican boundary.

It is not necessary to allude in the present preliminary essay to the general structural details of the family, as these are given with sufficient fullness in many systematic works, and also because all those structures which, by reason of diversification apparently afford efficient means of grouping the species, are men-

tioned in the tables given below or in the notes under the various generic headings. It should be stated, however, that the reason for the enormous proportion of new species here proposed, is to be found in the fact that the family has been almost totally neglected by systematists in this country for about thirty years, and that at the date of the last synopsis by LeConte, the extreme western country, where these forms particularly abound, had been scarcely explored in even a superficial manner. A very large number of new species will still have to be described by future investigators, for, at the present time every collection, however small, made in those regions with their numerous local faunas, is made up to a considerable extent of nondescripts.

The Melyridæ may be divided into two very unequal subfamilies, as follows:—

|   |           |
|---|-----------|
| Maxillary palpi cylindrical, the fourth joint pointed; eyes finely faceted and nude; tarsi with short stiff and inconspicuous hairs beneath.....                          | MELYRINÆ  |
| Maxillary palpi longer and much more developed, with the last joint large and triangular; eyes very coarsely faceted and setose; tarsi with long dense hairs beneath..... | RHADALINÆ |

The second of these subfamilies is composed at present of only two species, constituting the genus *Rhadasus* of LeConte, while the first probably numbers several hundred in the United States alone.

#### MELYRINÆ.

The Melyrinæ can be divided into two tribes, which however possess rather less than the usual tribal weight, as follows:—

|   |          |
|---|----------|
| Basal joint of the tarsi longer than the second, the tarsal claws generally appendiculate ..... | DASYTINI |
| Basal joint slightly shorter than the second; tarsal claws not appendiculate.                   | MELYRINI |

#### DASYTINI.

In distributing the multitudinous species of this tribe among numerous genera, the principal taxonomic elements employed refer, first, to the form, extent and position of the elytral epipleuræ, their plane being either horizontal, reflexed or inflexed, that is turned upward externally or internally respectively; secondly, to the extent and conformation of the submembranous unguinal appendages, and thirdly, to the presence or absence of external spines on the anterior tibiæ. Other characters are occasionally

employed to isolate certain aberrant forms, as may be seen from the following table :—

|   |    |
|---|----|
| Elytral epipleuræ distinctly defined, at least toward base.....                   | 2  |
| Elytral epipleuræ completely obsolete.....  | 13 |
| <b>2</b> —Epistoma obsolete, the frontal edge finely beaded throughout the width. |    |

**Pristoscelis**

|  |    |
|--|----|
| Epistoma distinct and generally well developed.....  | 3  |
| <b>3</b> —Ungual appendages mutually equal or nearly so, variable in development...  | 4  |
| Ungual appendages extremely unequal, the inner long and attached to the claw nearly throughout its length, the outer very rudimentary or altogether obsolete; pronotum constantly with a submarginal excavated line..... | 11 |
| Ungual appendages completely obsolete on both claws .....  | 12 |
| <b>4</b> —The appendages attached to the claws nearly throughout their own length.....   | 5  |
| The appendages detached and free nearly throughout their length, but well developed and as long as the claws.....  | 10 |
| <b>5</b> —Appendages well developed, as long as the claws or very nearly.....  | 6  |
| Appendages very short and rudimentary .....  | 9  |
| <b>6</b> —Anterior tibiæ beset externally with stout spinules.....   | 7  |
| Anterior tibiæ devoid of spinules, or with the latter few in number and very slender .....   | 8  |
| <b>7</b> —Epipleuræ broad and horizontal, abruptly vanishing at or very near the elytral apex.   |    |

Apical angles of the prothorax anteriorly prominent.....**Eudasytes**

Apical angles not prominent.....**Asydates**

Epipleuræ narrow, wider toward base, more or less strongly reflexed in plane throughout their length.

Antennæ short and not pilose.

Side margins of the prothorax not serrate.....**Trichochrous**

Side margins strongly serrate ..... **Cradytes** |

Antennæ long, strongly serrate and clothed with long sparse and flexible hairs .....

**Sydatopsis**

**8**—Ungual appendages slightly abbreviated and unequal, acutely pointed, the antennæ long and strongly serrate; tibiæ with slender setiform spinules.

**Sydates**

Ungual appendages generally fully as long as the claws ; tibiæ without spinules, except occasionally and inconspicuously in *Listrus*.

Prothorax broadly constricted near the apex.....**Listromimus**

Prothorax not at all constricted anteriorly.

Pronotum without a submarginal line.

Prothorax not dilated and serrulate at the sides toward base.

**Adasytes**

Prothorax dilated posteriorly and minutely serrulate at the sides.

**Listrus**

Pronotum with a submarginal delimiting line; species very small.

**Dasytellus**

9—Pronotum with a submarginal line delimiting a lateral rugose area.

**Dasytes**

Pronotum without trace of a submarginal line or lateral rugose area.

**Dasytastes**

10—Prothorax constricted near the apex and with a submarginal excavated line; plane of the epipleuræ gradually inflexed toward apex.

**Eschatocrepis**

11—Epipleuræ wide, horizontal, abruptly vanishing near the elytral apex; body parallel ..... **Allonyx**

Epipleuræ rather wide, horizontal throughout, gradually narrowed posteriorly; body cuneiform; head somewhat elongate ..... **Vectura**

Epipleuræ wide, gradually narrowed and inflexed in plane toward apex; body cuneiform ..... **Pseudallonyx**

Epipleuræ narrow, gradually very feebly defined and obsolete along the external flanks posteriorly; body subparallel and narrower in form.

**Leptovectura**

12—Head elongate; pronotum without a submarginal line..... **Mecomyceter**

13—Pronotum without a submarginal line; ungual appendages unequal.

**Dolichosoma**

This grouping is not altogether satisfactory, because of the proportionally large number of species comprised in only two or three of the twenty genera, and also for the reason that several of the genera now represented by single species have no very great individuality of habitus, and are to be distinguished by not more than one or two really radical differential characters; but I am unable to devise a more consistent or natural classification at the present time.

**PRISTOSCELIS** Lee.

The species described by LeConte under the name *Pristoscelis grandiceps*, offers so many points of divergence from the typical forms of *Trichochrous* that we are compelled to suggest its generic isolation. The epistoma, for example, is wholly obsolete, the apical margin of the front being finely beaded continuously from side to side; the labrum is relatively very small and strongly transverse, and the mandibles long and stout, the eyes small, prominent and very distant from the base, and the epipleuræ narrow but horizontal, the edges of the elytra being distinctly reflexed. The ungual appendages are as long as the claws and subequal, but the inner is detached from the claw through outer third of its length.

1. **P. grandiceps** Lec.—Proc. Acad. Nat. Sci., Phila., 1866, p. 355.

Parallel, moderately convex, highly polished, black, the elytra piceous-black; femora and tarsi dark rufo-ferruginous, the tibiae infusate except toward base; antennae piceous-black, testaceous toward base; pubescence very sparse, subcinereous and suberect, interspersed throughout the upper surface with numerous very long, erect and bristling black setae. Head large, about as wide as the prothorax in the male, polished, though very obsoletely reticulate, convex, minutely and sparsely punctate; frontal impressions very large, deep and remotely separated; eyes convex and prominent, the sides of the neck strongly convergent behind them; antennae well developed, nearly one-half longer than the prothorax, feebly serrate, joints six to ten subsimilar, feebly transverse and but slightly incrassate. Prothorax three-fifths wider than long, the sides strongly rounded just behind the middle, equally convergent and nearly straight thence to apex and base, all the angles obtuse and blunt but traceable; apex and base equal and equally arcuato-truncate; disk minutely and remotely punctate, perfectly smooth and polished to the extreme edges. Elytra but slightly more than one-half longer than wide, equal in width to the prothorax, parallel and straight at the sides, evenly and not very obtusely rounded at apex, rather coarsely and sparsely punctate. Length 3.7 mm.; width 1.3 mm.

California. A remarkably distinct species, described above from the male. I have not seen the female, which may differ greatly in the size of the head. The male sexual characters at the abdominal apex are very simple, the fifth segment being rather narrowly truncate at tip.

**EUDASYTES** n. gen.

The three species which it seems advisable to separate from *Trichochrous* under this name, do not form a very distinctly characterized genus, and differ only in having the epipleurae rather wide, flat and horizontal, and the lateral margins of the elytra narrowly reflexed, this being a consequence of the epipleural structure. Still, if we regard epipleural structure as one of the few important taxonomic elements in this tribe, it will certainly be necessary to form of these species a genus different from *Trichochrous*, and, after all, when we compare the structure of

the thoracic apex with the same part in Cradytes, where the apical angles so prominent here are completely obliterated and rounded, and the central portion of the apex correspondingly advanced, it would seem impossible to retain them all in the same generic group. The prominent apical angles of *Eudasytes* reappear feebly, however, in certain species of *Trichochrous*, and, in *Eudasytes ursinus* these angles are rounded and but slightly advanced; but, from the standpoint of epipleural structure, this species would have to form a subgenus of *Eudasytes*, showing that there may really be some correlation between the structure of the epipleuræ and form of the apical angles, at least in this particular genus.

The three species differ much among themselves and may be readily known as follows:—

Vestiture pale; apical angles of the prothorax strongly advanced and not or scarcely rounded; epipleuræ remaining horizontal to the extreme apex; legs pale.

Basal angles of the prothorax not prominent; erect setæ of the elytra very short; body much broader.....1 **amplus**

Basal angles laterally prominent; erect setæ long; body more elongate.

2 **oblongus**

Vestiture blackish; apical angles feebly produced anteriorly and rounded; plane of the epipleuræ inflexed toward apex; legs black .....3 **ursinus**

As far as known the species are distributed through the arid region extending from Utah to southern California, and probably do not occur in the true Pacific coast fauna.

1. **Eu. amplus** n. sp.—Oblong, very stout, rather strongly convex, polished, black, without distinct metallic lustre; legs pale, rufo-ferruginous, the coxæ, tibiæ and tarsi slightly obscure; femora slightly piceous along the upper edge; antennæ piceous, blackish toward apex; pubescence short, sparse, coarse and cinereous, intermixed with very short and more erect pale hairs; marginal cilia pale, moderate in length. *Head* slightly more than one-half as wide as the prothorax, smooth, convex, finely and rather closely punctate, the impressions long and distinct, confluent at apex behind a distinctly elevated frontal margin; epistoma long, truncate, pale and coriaceous; labrum long, blackish, rounded; eyes rather large and somewhat prominent; antennæ rather distinctly shorter than the prothorax, feebly incrassate, the penultimate joints transverse, fifth scarcely preceptibly dilated. *Prothorax* large and convex, fully three-fourths wider than long, the sides parallel and just visibly arcuate, becoming gradually strongly, evenly arcuate and convergent near the apex, the apical angles greatly advanced anteriorly, right and scarcely at all rounded, apex much narrower than the base, deeply emarginate, transverse between the



angles; base broadly arcuate, oblique and straight toward the basal angles, which are obtuse but not at all rounded, and with a thick confusedly punctate bead; disk finely, sparsely punctate, smooth and polished, only very feebly rugulose near the sides. *Elytra* scarcely more than one-third longer than wide, a little wider than the prothorax and somewhat more than twice as long, parallel, the sides feebly arcuate, becoming straight near the base; disk obliquely narrowed at apex, each elytron rounded; lateral margins reflexed; punctures fine and rather sparse. *Abdomen* more densely cinereo-pubescent. Length 3.8 mm.; width 1.9 mm.

California.

The description refers to a single female type from an unrecorded part of the State. The epipleuræ are rather wide, subhorizontal, polished and impunctate, becoming inwardly arcuate at tip and vanishing only at the beginning of the rounded apical angles. It is probable that the male will be found to differ considerably in general form.

2. ***Eu. oblongus*** n. sp.—Oblong, stout, strongly convex, polished, black, without metallic lustre, the elytra somewhat piceous; legs pale rufo-ferruginous throughout, the coxæ dark; antennæ rufo-testaceous, blackish toward apex and also at the inner extremities of the intermediate joints; pubescence cinereous, subdecumbent, long and very sparse anteriorly, rather dense and intermingled with sparse erect pale setæ throughout on the elytra, the head with a few bristling setæ; marginal cilia long and rather confused. *Head* scarcely more than three-fifths as wide as the prothorax, smooth, finely, sparsely punctate, the impressions long and pronounced, extending almost to the occiput; epistoma somewhat short; labrum moderate, rounded; eyes rather large, moderately convex; antennæ stout, serrate, incrassate, moderate in length, the penultimate joints strongly transverse. *Prothorax* three-fifths wider than long, the sides very slightly convergent and extremely feebly arcuate from base to apex, the basal angles nearly right, not rounded and distinctly prominent laterally; apical angles prominent anteriorly, acute and not in the least blunt; apex slightly narrower than the base, broadly, arcuately emarginate; base very feebly arcuate toward the middle; disk minutely and remotely punctate, not in the least rugose near the sides. *Elytra* two-fifths longer than wide, not wider than the prothorax, parallel and straight at the sides, broadly rounded at apex, each elytron narrowly truncate, with the sutural angle blunt; disk narrowly reflexed at the lateral margins, rather finely but strongly and somewhat closely punctured. *Abdomen* a little more densely cinereo-pubescent. Length 2.9–4.8 mm.; width 1.4–2.2 mm.

Utah (southwestern). Mr. C. J. Weidt.

The male described has the fifth ventral truncate at apex, the genital segment flat, finely canaliculate along the middle and sinuato-truncate at apex and the inner spur of the anterior and

middle tibiae moderately dilated, the anterior tibiae and tarsi unmodified. The female has the head about one-half as wide as the prothorax, the latter three-fourths wider than long and still quite as wide as the elytra, with the sides rounded and convergent near the apex, and the elytra somewhat more than one-half longer than wide. The individuals vary greatly in size independently of sex. Six specimens.

The epipleuræ are flat, horizontal, polished and glabrous, curving inward posteriorly and ending at the narrow apical truncature.

3. ***Eu. ursinus*** n. sp.—Oblong, stout, strongly convex, polished, intense black throughout, without metallic lustre; legs and antennæ black; vestiture rather long, sparse, blackish, intermixed with numerous long erect black setæ, especially abundant on the elytra; marginal cilia black, long but somewhat fimbriiform. *Head* but slightly more than one-half as wide as the prothorax, smooth, finely and sparsely punctate, the impressions moderate in size and distinctness; epistoma rather short, dark; labrum strongly rounded, gradually slightly pale toward tip; eyes large but not very prominent; antennæ stout, one-third longer than the prothorax, distinctly incrassate toward tip, the penultimate joints transverse, fifth scarcely dilated. *Prothorax* very nearly twice as wide as long, the sides parallel and very feebly arcuate, slightly convergent and more arcuate near the deflexed apical angles, which are but slightly prominent anteriorly and somewhat broadly rounded, basal angles slightly obtuse and distinct, not rounded; apex subequal to the base, truncate; base broadly arcuate; disk strongly convex, finely, remotely punctate. *Elytra* scarcely more than one-half longer than wide, equal in width to the prothorax, parallel and straight at the sides, evenly and not broadly rounded at apex, the sutural angles not very blunt; disk narrowly reflexed along the side margins, rather coarsely and sparsely punctate, the interspaces polished. *Abdomen* moderately densely clothed with short plumbeo-cinereous pubescence. Length 3.0–3.2 mm.; width 1.4 mm.

Southern California.

This species may be recognized by its black color and long hispid black setæ. The description is drawn from the male, in which sex the fifth ventral is but little longer than the fourth, slightly trapezoidal and truncate at apex. The female differs only slightly, the elytra being fully three-fifths longer than wide and somewhat wider than the prothorax, the sides of the latter more arcuate; the head is fully as large or even somewhat larger, when compared with the prothorax, in the female than in the male. Two specimens.

The epipleuræ are flat and horizontal, and, at the apex, have their plane turned somewhat inward and upward.

**ASYDATES** n. gen.

This genus differs but slightly from *Trichochrous*, but the small prothorax and broad subdepressed elytra, which are narrowly reflexed at the sides, give to the two species which at present compose it, a facies which is quite peculiar and distinctive; the general habitus is in fact intermediate in some respects between *Trichochrous* and the genera allied to *Allonyx*. The epipleuræ are broad and flat, and this character distinguishes it at once from *Trichochrous*, although in other structural features it is virtually similar. The epipleuræ are relatively altogether as wide as in *Eudasytes*, or even wider; they do not, however, follow the apical curve of the elytra as in that genus, but become abruptly obsolete at a greater distance from the apex. The species are mutually very distinct in appearance and may be thus distinguished:—

Pubescence coarse and rather dense, not intermingled with erect hairs; abdomen entirely red .....1 **rufiventris**  
 Pubescence fine and very sparse, intermixed with short but inconspicuous erect hairs; abdomen red, blackish near the base .....2 **explanatus**

It is probable that this genus is local and confined to the coast regions of California near Santa Barbara and Los Angeles, a faunal region which is known to support a considerable proportion of endemic forms.

1. **A. rufiventris** n. sp.—Oblong, suboval, broad and subdepressed, black, with a strong æneous lustre; elytral apices, abdomen and legs throughout pale rufous; antennæ darker, testaceous, blackish toward apex; integuments strongly shining; pubescence rather coarse, long and somewhat dense, closely decumbent, pale fulvous and very conspicuous, without trace of intermixed erect setae; marginal cilia short, dense and fimbriiform, longer on the elytra. *Head* two-thirds as wide as the prothorax, nearly smooth, very obsoletely reticulate, finely, sparsely punctate; impressions feeble and widely separated; epistoma very short and broad; labrum short, subtruncate at apex; eyes large but not prominent, nearly attaining the base; antennæ but little longer than the prothorax, feebly serrate, slightly incrassate, the penultimate joints transverse. *Prothorax* three-fifths wider than long, widest just visibly behind the middle, the sides subparallel and strongly rounded; apex arcuato-truncate, slightly narrower than the base; all the angles very obtuse and more or less rounded; disk finely, sparsely punctate, the interspaces smooth, not rugose laterally. *Elytra* scarcely two-fifths longer than wide and nearly one-half wider than the prothorax, the sides subparallel and nearly straight; apex almost evenly and not obtusely rounded; humeri broadly exposed at base;

lateral edges reflexed; punctures not very coarse but strong and rather sparse; edges toward apex finely serrulate. *Abdomen* not very densely but coarsely cinereo-pubescent. Length 2.7 mm.; width 1.25 mm.

California (Santa Barbara).

The male type has the fifth ventral distinctly longer than the fourth, and broadly flattened or impressed and truncate at apex almost throughout the entire width, the impression obsolete toward base, more broadly toward the middle. In the female the head is scarcely visibly smaller when compared with the prothorax, but the latter is distinctly wider in reference to the elytra being at its widest part fully as wide as the elytral base, which in the male is much narrower. Four specimens.

The epipleuræ are very wide, almost horizontal and finely, sparsely punctate and pubescent, becoming obsolete at a considerable distance from the elytral apices and scarcely at all curved inward posteriorly.

2. **A. explanatus** n. sp.—Oblong, broad, subdepressed, polished, black, without metallic lustre, the elytral apices and abdomen, except near the base, pale rufous; legs piceous-black, the tibiæ and tarsi rufescent; antennæ blackish, rufescent toward base; pubescence fine, sparse, rather short and cinereous, intermixed with short fine erect hairs of the same color; marginal cilia short. *Head* three-fourths as wide as the prothorax, smooth throughout, rather coarsely but sparsely punctate, the impressions large and widely separated; epistoma very short and broad; labrum transverse, truncate at apex; eyes moderate in size, not very convex; antennæ slightly longer than the prothorax, serrate, all the joints asymmetric, the fifth and sixth subequal and rather wider than seven to nine, tenth moderately transverse. *Prothorax* about one-third wider than long, the sides strongly arcuate, becoming gradually convergent and less arcuate toward apex, the latter feebly arcuate, much narrower than the base, which is still more arcuate; basal angles extremely broadly rounded and wholly obliterated, the apical deflexed and broadly rounded; disk convex, rather coarsely but sparsely punctate, smooth, not at all rugose toward the sides. *Elytra* a little more than one-half longer than wide, nearly one-half wider than the prothorax, parallel, feebly dilated with the sides slightly arcuate, becoming parallel very near the base; apex broadly, evenly rounded, the sutural angles right and scarcely at all blunt; disk subexplanate and with the edge strongly serrulate externally at apex; lateral edges reflexed; punctures coarse, deep and sparse. *Abdomen* very sparsely and rather coarsely cinereo-pubescent. Length 3.3 mm.; width 1.4 mm.

Southern California. Mr. H. C. Fall.

The single specimen before me is a female, having the fifth ventral segment broadly rounded. The species differs greatly from

*rufiventris* in its longer form of body, coarser punctuation and sparser and dual vestiture. The pale color at the elytral apex ascends at the lateral margins to about the middle, gradually becoming faint.

The epipleuræ are flat, almost horizontal, polished, and very remotely and almost imperceptibly punctulate and pubescent.

### TRICHOCHROUS Motsch.

*Byturosomus*; *Emmenotarsus* Mots; *Pristoscelis* Lec. (pars.).

Within the broad compass which we are compelled to give it, this genus is in all probability one of the largest of the North American Coleoptera, its species occurring in unnumbered scores in the extreme western regions of the continent, and especially in California, where it constitutes one of the chief arboreal elements of the order. Its species differ much among themselves in size and vestiture, but agree in having the appendages of the tarsal claws well developed, equal, as long as the claws and attached to them except in outer third or fourth of their length; these appendages are of a gelatino-membranous texture, and subject to malformation or distortion which is frequently deceptive and misleading, especially under low powers of amplification. The species may be distinguished from *Eudasytes* and *Asydates* by the structure of the epipleuræ, and from *Listrus* and its allies by having the outer surface of the anterior tibiæ—and of the others to a less extent—beset with an irregular and partially double series of short stiff and widely spaced spinules. The body may be simply pubescent or have erect setæ in addition, and may have a dense thoracic fringe of short cilia as in *Listrus*; this regular fringe is however generally wanting in those species which bristle with long erect setæ.

The sexual characters are usually quite distinct though only rarely very radical, but the sexes are nearly always readily differentiable. The male as a rule has the head, and less frequently the prothorax, larger, the antennæ longer, and the elytra relatively shorter than the female. The abdominal characters are generally feeble, the fifth ventral in the male being more or less evenly truncate, but in a singular exception described below under the name *sexualis*, this segment becomes strongly modified, an exception quite as pronounced as that of *Cistela brevis* when com-

pared with *C. theveneti* (Col. Not. III., p. 163). The third and fourth segments in the males of certain small species with pale elytra have a cluster of short radiating spinules in the middle. The genital segment varies but little; it is generally emarginate in the male and more or less truncate in the female, and is impressed along the middle in both sexes. Beyond the genital segment the under part of the dorsal pygidium gives the appearance of still another terminal segment; this inferior surface is more developed in the male. The fifth ventral in the female is always more or less rounded, and its surface is sometimes feebly impressed. In the male the inner spur of the anterior and middle tibiæ is dilated, sometimes very strongly, while in several species I have been unable to notice any modification of the spurs, and in the male of *sexualis* the inner spur is dilated on all the tibiæ. In a few species, such as *fuscus*, the anterior tibiæ are slightly thickened or bent in the male, but as these tibial modifications are rare and slight I have not searched for them with special care.

The literature of this genus is confused in an inexplicable manner. The typical form was described by Motschulsky, and the genus limited by him to three species having uniform pubescence without intermixed erect hairs, certain other species such as *griseus* and *conformis*, which, with the large material before me, are not separable from *Trichochrous*, being at the same time made the types of the genera *Byturosomus* and *Emmenotarsus*. When Dr. LeConte published the first edition of the "Classification" in 1861, he for some undiscoverable reason discarded all of Motschulsky's names, and proposed "*Pristoscelis*" for the consolidated genera of that author. This course was certainly unwarranted, and however much it might be desired on personal or other grounds to retain the name given by LeConte, I feel sure that the adoption of it under the circumstances would be a violation of the laws of priority, as well as some of the principles of ordinary justice and equity. But even if we agree to adopt the name *Pristoscelis*, the condition of the question is not materially improved, because the original definition states that the prothorax is "not serrate or ciliate at the sides," and this would exclude all of Motschulsky's *Trichochrous* proper, as well as *serricollis* and *serrulatus*, which were subsequently added.

In describing *Byturosomus* from the type *griseus*, Motschulsky changed the name to *rufipes*, which of course could not hold, as

*griseus* was certainly not a preoccupied name in *Byturosomus* or *Pristoscelis*, although LeConte himself seems to have agreed to the change even in the second edition of the "Classification." In his revision of the *Dasytini* (Proc. Acad., Phila., 1866, p. 351) LeConte assumes that Motschulsky did not know his *griseus*, but had mistaken *fuscus* for it; but this idea seems to have been subsequently abandoned, for (Class. 2 ed., p. 215) *Byturosomus* is said to have been founded upon "*D. rufipes* Motsch. (*griseus* || Lec.)." Finally (l. c., p. 353) LeConte states that *griseus* Lec. and *antennatus* Motsch., are identical, and places the former as the synonym, although it antedates *antennatus* by some seven years.

It is not possible that more than a fraction of the species can be defined in the following table, and it is only hoped that the short characterizations may prove of some avail as an index to the descriptions. The species are rather monotonous, though apparently not especially variable within the limits of the respective sexes except in size; the sexual differences in outline are however sometimes pronounced, as before remarked:—

- |   |                       |
|---|-----------------------|
| Body clothed with subdecumbent hairs, without trace of intermixed erect setæ; marginal cilia of the prothorax generally short and pale in color...  | 2                     |
| Body clothed with dense subdecumbent and cinereous pubescence, which is intermixed, at least toward the sides of the elytra, with short sparse and erect cinereous setæ which frequently seem to be subserial in arrangement; fringe at the sides of the prothorax usually short, even and close-set..... | 16                    |
| Body clothed with short cinereous or blackish subdecumbent pubescence, intermixed abundantly with long hispid hairs, black or cinereous in color, the hairs at the sides of the prothorax long, erect and bristling, and not forming a regular or close-set fringe .....                                  | 22                    |
| Body clothed with moderately long suberect blackish pubescence, the marginal fringe of the prothorax composed of rather short even and stiff black hairs .....  | 36                    |
| <b>2</b> —Elytral pubescence uniform in structure and distribution .....  | 3                     |
| Elytral pubescence uneven in structure and distribution.....  | 15                    |
| <b>3</b> —Elytra uniform in coloration, black or slightly piceous.....  | 4                     |
| Elytra pale or bicolored. ....  | 13                    |
| <b>4</b> —Apical angles of the prothorax more or less anteriorly prominent.   |                       |
| Basal angles of the prothorax prominent.  |                       |
| Apical angles broadly rounded .....   | 1. <b>compactus</b>   |
| Apical angles not rounded.....  | 2. <b>brevis</b>      |
| Basal angles broadly obtuse and rounded, the apical narrowly rounded and only slightly blunt.   |                       |
| Elytral pubescence coarse, dense and cinereous.....   | 3. <b>oregonensis</b> |

- Elytral pubescence fine, sparse and dark in color.....4. **agrestis**  
 Apical angles not at all prominent anteriorly, the apex transversely truncate  
 or feebly arcuate .....5  
**5**—Larger species, seldom at all under 3 mm. in length .....6  
 Small species, always under 3 mm. in length .....7  
**6**—Prothorax short, one-half or more wider than long.  
 Sides of the prothorax parallel.  
 Prothorax distinctly less than twice as wide as long.  
 The sides evenly and very feebly arcuate; elytral pubescence rather  
 long and dense.....5. **fraternus**  
 The sides evenly and less feebly arcuate; elytral pubescence very short  
 and much more sparse (*ater* Bland).....6. **cylindricus**  
 The sides evenly and very strongly arcuate; elytral pubescence rather  
 short and only moderately dense.....7. **laticollis**  
 The sides broadly subangulate behind the middle; pubescence con-  
 spicuous .....8. **castus**  
 The sides broadly and strongly sinuate in apical half.....9. **sinuosus**  
 Prothorax very nearly twice as wide as long.....10. **transversus**  
 Sides of the prothorax slightly convergent, the apex somewhat narrower  
 than the base; body strongly convex and very sparsely pubescent.  
 Prothorax feebly narrowed anteriorly, widest at or near the base; an-  
 tennæ rapidly incrassate toward tip.....11. **sparsus**  
 Prothorax less transverse, more strongly narrowed anteriorly, widest dis-  
 tinctly before the base; antennæ scarcely at all incrassate..12. **ciliatus**  
 Prothorax much less transverse, the sides feebly convergent from base to apex  
 and just visibly, evenly arcuate; vestiture coarse but very short, easily  
 denuded .....13. **atricornis**  
**7**—Sides of the prothorax parallel or very nearly so.  
 Body narrow and elongate, the elytral vestiture rather dense; thoracic cilia  
 shorter and fimbriform.....14. **fulvotarsis**  
 Body stouter, densely pubescent; thoracic cilia longer...15. **antennatus**  
 Body shorter, the vestiture sparse; thoracic cilia long and not fimbriform.  
 Elytral punctures fine .....16. **discipulus**  
 Elytral punctures coarse.....17. **femoralis**  
 Sides of the prothorax convergent from near the base; body somewhat as in  
*Listrus*, but with the anterior tibiae strongly spinose and the sides of the  
 prothorax devoid of serrulation.....8  
**8**—Pronotum shining and sparsely punctate; legs clear rufous throughout.....9  
 Pronotum densely sculptured.....12  
**9**—Body stout; elytral punctures sparse.....10  
 Body less stout, the elytral punctures close-set .....11  
**10**—Elytral pubescence very coarse.....18. **griseus**  
 Elytral pubescence fine.  
 Punctures of the pronotum fine throughout; marginal cilia of the elytra  
 long, slender and erect.....19. **simulans**  
 Punctures coarser, especially toward the sides; elytral cilia short, coarse  
 and recurved .....20. **modestus**



**11**—Marginal cilia of the elytra longer, rather sparse and more erect.

Prothorax feebly transverse; elytral pubescence very fine..21. **separatus**

Prothorax strongly transverse; elytral pubescence coarse and closely decumbent; body much smaller.....22. **pudens**

Marginal cilia of the elytra forming a short dense and posteriorly recurved fringe; body small and conspicuously pubescent.....23. **indigens**

**12**—Marginal cilia of the elytra long, sparse, erect and bristling; legs red, the femora slightly piceous.....24. **incipiens**

Marginal cilia shorter, denser, even and recurved, femora pale and clear rufous, the tibiæ piceous-black .....25. **erythropus**

**13**—Larger species, more than 3 mm. in length; prothorax strongly narrowed anteriorly.....26. **convergens**

Small species, always much under 3 mm. in length.....14

**14**—Elytra dark, with the apical margin pale.

Body slender, the elytra rather sparsely punctured.....27. **innocens**

Body very stout, oblong-oval, the elytra densely punctured..28. **apicalis**

Elytra pale, each blackish along the middle, the sutural pale area gradually narrowed, disappearing near the base; prothorax transversely parallelogramic in form.....29. **egenus**

Elytra pale, with a common and clearly defined triangular dark area at base.

30. **umbratus**

Elytra pale, indefinitely clouded with blackish toward the suture and base.

Pubescence coarse; head in the male wider than the anterior margin of the prothorax.....31. **nubilatus**

Pubescence fine and sparse; head in the male barely as wide as the anterior margin of the prothorax.....32. **suffusus**

Elytra generally pale flavo-testaceous throughout. \*

Head and prothorax black.

Marginal cilia of the prothorax short; abdomen red, black at base.

33. **propinquus**

Marginal cilia much longer and more conspicuous; head in the male large, wider than the anterior parts of the prothorax; abdomen black.

34. **fulvovestitus**

Head and prothorax pale testaceous, except a large spot of black at the base of the former; head large in the male.....35. **exiguus**

Head and prothorax pale testaceous throughout; head small in both sexes.

36. **testaceus**

**15**—Sides of the prothorax parallel or very nearly so.

Apical angles of the prothorax right and only slightly blunt; elytral vestiture, consisting of coarse sparse and white and more slender dark hairs of equal length, confusedly intermingled over the entire surface.

37. **fallax**

Apical angles broadly rounded, the sides broadly arcuate; pubescence of the elytra coarser and white along the suture and externally, sparsely punctate.

Pronotal punctures rather coarse and somewhat impressed.

38. **inaequalis**

- Pronotal punctures fine.....39. **subcalvus**
- Sides of the prothorax distinctly convergent anteriorly.
- Pronotum strongly and rather closely punctured; white hairs of the elytra few in number and irregularly disposed.....40. **funebri**
- Pronotum finely and remotely punctured; fine dark hairs of the elytra forming a submedian vitta on each.....41. **vittiger**
- 16**—Apical angles of the prothorax anteriorly prominent.
- Basal angles acute and prominent.....42. **prominens**
- Basal angles broadly rounded; vestiture very dense.
- Vestiture cinereous-white; prothorax feebly transverse.
43. **cuspidatus**
- Vestiture pale helvo-cinereous; prothorax strongly transverse.
44. **indutus**
- Apical angles not at all prominent anteriorly.....17
- 17**—Sides of the prothorax subangulate behind the middle, the marginal fringe very dense and conspicuous; legs piceous-black; vestiture fulvous.
45. **fimbriatus**
- Sides of the prothorax almost evenly arcuate.....18
- 18**—Prothorax feebly transverse, the sides very feebly arcuate, the basal angles slightly obtuse but distinct; vestiture short and dense, the erect white hairs unusually short; legs piceous-black.....46. **pruinus**
- Prothorax strongly transverse.....19
- 19**—Erect hairs of the elytra distinct over the entire surface and apparently somewhat serial in arrangement.....20
- Erect hairs of the elytra extremely feebly developed and only visible toward the sides.....21
- 20**—Body very broad, especially in the female, oblong, the sexual differences unusually marked; side margins of the pronotum narrowly reflexed.
47. **fuscus**
- Body less broad, differing but little sexually; side margins of the pronotum not noticeably reflexed.
- Head in the male fully three-fourths as wide as the prothorax; femora usually blackish.....48. **seriellus**
- Head in the male not more than three-fifths as wide as the prothorax; legs red; body still narrower in both sexes.....49. **sobrinus**
- 21**—Prothorax distinctly narrowed anteriorly, less transverse; vestiture very dense .....50. **mucidos**
- Prothorax parallel and strongly arcuate at the sides.
- Vestiture dense.....51. **brevicornis**
- Vestiture much sparser.....52. **vilis**
- 22**—Pubescence of the elytra uneven in distribution.....23
- Pubescence of the elytra uniform in distribution or virtually so and pale in color .....24
- Pubescence of the elytra uniform in distribution and practically altogether black or brownish-black in color.....33
- 23**—The dark hairs forming two large quasi-denuded spots on each elytron.
- Legs black or piceous-black.....53. **insignis**

- Legs red; prothorax shorter and more transverse.....54. **curticollis**  
 The pale hairs concentrated in a distinctly defined sutural streak or vitta.  
 Prothorax large, in great part clothed with long, sparse and erect setæ which  
 are black in color (*conformis* Lec.).....55. **suturalis**  
 Prothorax small, densely clothed with decumbent fulvous pubescence, a  
 well defined median vitta dark .....56. **varius**  
 The pale hairs scattered over the elytra, but generally sparser or wanting in a  
 longitudinal and more or less incomplete line near the suture.  
 Punctures fine; legs black or piceous-black.  
 Pronotum clothed in great part with dark hairs; pale hairs of the elytra  
 very sparse.....57. **quadricollis**  
 Pronotum clothed in great part with pale pubescence.  
 Pale hairs of the elytra very sparse; elytra transversely and broadly  
 impressed near the base.....58. **remotus**  
 Pale hairs very numerous; elytra not impressed; body much narrower.  
 59. **conspersus**  
 Punctures coarse; legs bright ferruginous throughout....60. **mexicanus**  
**21**—Very large species, more than 5 mm. in length, black, with the elytra  
 pale and rufous throughout.....61. **rufipennis**  
 Moderate or small species, always under 4 mm. in length; body almost invari-  
 ably unicolorous.....25  
**25**—Decumbent pubescence dense, the general aspect cinereous or fulvous...26  
 Decumbent pubescence sparse, the general aspect of the body blackish from  
 non-concealment of the surface.....29  
**26**—Legs black or piceous .....27  
 Legs red.....28  
**27**—Sides of the prothorax parallel or extremely nearly so and evenly arcuate.  
 Erect black hairs only visible toward the sides of the prothorax; erect hairs  
 of the elytra coarse, abundant, only moderately long and pale cinereous  
 throughout.....62. **lobatus**  
 Erect black hairs few in number, unusually short and inconspicuous, scarcely  
 noticeable on the elytra except toward the sides, where they are mingled  
 with a greater number of white hairs.....63. **brevipilosus**  
 Erect black hairs very long and conspicuous throughout the upper surface.  
 Decumbent pubescence of the elytra short and not wholly concealing the  
 surface, the erect black hairs very abundant.  
 Sides of the prothorax strongly arcuate; body short.....64. **hystrix**  
 Sides of the prothorax feebly arcuate; body elongate and parallel.  
 65. **barbaræ**  
 Decumbent pubescence long and extremely dense, the long erect hairs  
 sparse; large species.....66. **tectus**  
 Sides of the prothorax rounded and convergent only near the apex; body ob-  
 long-oval .....67. **sordidus**  
 Sides convergent and nearly straight from near basal third; erect hairs very  
 long, white on the elytra, with a few black intermingled..68. **villosus**  
 Sides of the prothorax convergent from base to apex and feebly arcuate; erect  
 hairs of the elytra conspicuous; rather large species.....69. **irrasus**

**28**—Prothorax parallel and moderately arcuate at the sides; erect black hairs long but rather sparse.....70. **crinifer**

Prothorax narrowed at apex.

Pubescence cinereous; erect hairs moderately long, abundant; elytra generally distinctly paler at the apical margin.....71. **hirtellus**

Pubescence bright fulvous; erect hairs very long, bristling and abundant.

72. **fulvescens**

**29**—Large species, 4 mm. in length; prothorax transversely elliptical and very coarsely punctured.....73. **comatus**

Smaller species, seldom sensibly more than 3 mm. in length.....30

**30**—Legs black to dark rufo-piceous in color; sides of the prothorax parallel and strongly arcuate. ....31

Legs bright rufo-ferruginous in color.....32

**31**—Long hairs of the elytra conspicuous.

Male with feeble sexual modification (*tejonius* Lec.).....74. **squalidus**

Male with pronounced sexual modification at the ventral apex.

75. **sexualis**

Long hairs of the elytra very inconspicuous and inclined.....76. **sonomæ**

**32**—Basal angles of the prothorax obtuse.

Prothorax narrowed anteriorly, strongly punctate.....77. **texanus**

Prothorax parallel, finely punctate.....78. **lucidus**

Basal angles acute and everted, the sides convergent anteriorly...79. **reversus**

**33**—Sides of the prothorax parallel and arcuate. ....,.....34

Sides of the prothorax convergent anteriorly; marginal cilia short and fimbriiform.....35

**34**—Legs dark red; integuments polished, with an æneous lustre, the elytral punctures very coarse and sparse.....80. **pedalis**

Legs black or piceous.

Elytral punctures fine.....81. **nigrinus**

Elytral punctures coarse.

The punctures somewhat unequal.

Punctures very sparse; integuments with a feeble subæneous lustre; sides of the prothorax strongly rounded behind the middle.

82. **ænescens**

Punctures less sparse; lustre non-metallic; sides of the prothorax very feebly rounded .....83. **rusticus**

The punctures even, deep and distinctly defined; sides of the prothorax almost evenly and strongly rounded throughout.....84. **politus**

**35**—Erect hairs of the upper surface not evident; edges of the elytra serrulate at apex; small species, the body somewhat depressed.

85. **punctipennis**

**36**—Prothorax constricted at the sides behind the apex....86. **stricticollis**

One of the three species described by Motschulsky (Bull. Mosc., 1859, ii., p 393) remains unidentified and is described as follows:

“*Alatus, elongatus, subovatus, subconvexus, punctatissimus, cinereo pub-*

escens, nigro-æneus, ore, oculis, antennis pedibusque nigris; fronte inter antennas tuberculo nitidissimo armata; thorace capite latiore, subtransverso, antice vix angustato, basi arcuato, angulis posticis distinctis, obtusis, lateribus subarcuatis, marginatis; elytris thoracis latitudine vix superantibus, parallelis, postice arcuatim attenuatis; antennis subcompressis, articulis transversim triangularis, 5- to paulo dilatato. Long. 1 l.—lat.  $\frac{2}{3}$  l." California [Dupont].

#### 87. **californicus**

The subjoined remarks give but little aid in identification and need not be quoted.

1. **T. compactus** n. sp.—Oblong, rather stout, strongly convex, polished, piceous-black, the elytra rufo-castaneous; under surface, legs and antennæ dark rufous throughout; pubescence coarse, decumbent, moderately short and dense, pale ochreo-cinereous in color, the marginal fringe of the prothorax and elytra moderate in length. *Head* slightly more than one-half as wide as the prothorax, flat, broadly impressed anteriorly, finely, sparsely punctate, the interspaces smooth; epistoma abruptly depressed, pale, coriaceous and impunctate; labrum short, broadly arcuate at apex, the disk finely and remotely but distinctly punctate, the punctures bearing short erect setæ; eyes rather large but not prominent; antennæ somewhat slender, subequal in length to the prothorax, the fifth and seventh joints larger than the sixth and eighth, penultimate wider than long. *Prothorax* large, broadly campanulate, about one-half wider than long, the sides broadly rounded and convergent toward apex, outwardly sinuate toward base, the basal angles acute and strongly everted; apex feebly sinuato-truncate, the angles broadly rounded; disk minutely, sparsely punctate throughout, the interspaces smooth and polished. *Elytra* only slightly wider than the prothorax, scarcely more than one-half longer than wide, two and one-half times as long as the prothorax, parallel and straight at the sides, broadly, obtusely rounded at apex, the vertical flanks longitudinally impressed toward base; humeri obtusely prominent; disk finely, evenly and somewhat closely punctate. *Abdomen* finely, rather closely punctate, the interspaces not reticulate. Length 3.4 mm.; width 1.5 mm.

Southern California.

The single type of this somewhat aberrant species is a female; it may be readily identified by the campanulate prothorax, with acute and everted basal and rounded apical angles.

2. **T. brevis** n. sp.—Short and very broad, moderately convex, shining, black throughout, the legs rufo-piceous, the antennæ throughout dark piceous-brown; pubescence moderately long and dense, pale luteo-cinereous, the hairs along the lateral edges rather long, erect and bristling. *Head* but slightly more than one-half as wide as the prothorax, finely, remotely punctate, the upper surface perfectly flat throughout, without trace of subapical impression but with a broad and feeble swelling at the middle near the frontal margin; epistoma abruptly depressed, short, truncate but scarcely paler; labrum feebly punctulate toward the sides; eyes large but not prominent; antennæ somewhat

slender, distinctly longer than the prothorax, the penultimate joint nearly one-half wider than long, fifth and seventh scarcely enlarged. *Prothorax* short and transverse, three-fourths wider than long, gradually and only slightly narrowed in apical half, the basal angles acute and everted; apex transversely truncate, anteriorly oblique at the sides, the apical angles anteriorly prominent but rather blunt; disk smooth and polished, finely and sparsely punctate throughout. *Elytra* short, scarcely more than one-third longer than wide, fully two-fifths wider than the prothorax, parallel and straight at the sides, the apex extremely broadly and obtusely but evenly rounded; side margins somewhat reflexed, the vertical flanks impressed; humeri slightly tumid; disk finely, evenly and moderately closely punctate, *Abdomen* finely and closely punctulate, the legs somewhat stout; hind tarsi distinctly shorter than the tibiae. Length 2.9 mm.; width 1.6 mm.

#### California.

The only known specimen of this species is likewise a female, and is from an unrecorded part of the State. The species is remarkably distinct in the prominent apical and acutely everted basal angles of the prothorax, and in the very short broad form of the body. The epipleuræ are not much wider than in the ordinary species of the genus, and are gradually narrowed behind, but they are nevertheless somewhat intermediate between the usual type and the broad horizontal form characterizing the genus *Eudasytes*.

3. **T. oregonensis** Lec.—Proc. Acad. Nat. Sci., Phila., 1866, p. 351 (Pristoscelis.)

Oblong-elongate, strongly convex, black, the upper surface with a feeble æneous lustre; legs and antennæ throughout black; pubescence cinereous, moderately dense, long and coarse, sparse anteriorly; marginal cilia rather short. Head three-fourths as wide as the prothorax, feebly convex, feebly constricted at base, the eyes large and somewhat prominent; punctures fine and sparse, subrugose; front broadly bi-impressed; epistoma thin, truncate; labrum long, parabolic, only punctured at base, pale at apex; antennæ slender, slightly longer than the prothorax, the fifth joint wider than the fourth and wider and much longer than the sixth, tenth nearly as long as wide. Prothorax fully one-half wider than long, the sides subparallel, very feebly convergent in apical, more strongly so and more rounded in basal half, the basal angles obtuse but slightly reflexed dorsally; apex transversely truncate, wider than the base, anteriorly oblique at the sides, the apical angles prominent but not very acute; disk strongly and

rather closely punctate and subrugose, coarsely reto-scabrous near the sides. Elytra parallel, two-thirds longer than wide, only slightly wider the prothorax and nearly three times as long, side margins narrowly reflexed; punctures somewhat fine and close-set, scabriculate. Abdomen minutely, densely asperulo-punctate, the legs rather long. Length 3.8 mm.; width 1.5 mm.

Oregon. The male from which the description is taken has the fifth ventral unmodified on the disk, short and broadly truncate at apex; the genital segment is flat, emarginate, with about three long erect black setæ at each side, and the under surface of the tip of the dorsal pygidium is distinct beyond it. The epipleuræ are wider than in most species of the genus, but are gradually narrowed behind.

4. **T. agrestis** n. sp.—Elongate and convex, moderately shining, black throughout; legs and antennæ dark rufo-piceous, the first and eleventh joints of the latter black; pubescence very short, fine and closely decumbent, brownish-black in color and inconspicuous, the marginal fringe short, even and dark in color. Head three-fourths as wide as the prothorax, feebly constricted at base, sparsely punctate, the punctures fine, coarser and with scabrous sculpture toward base; frontal impressions large and feeble; eyes large, slightly prominent and distant from the base; epistoma thin and truncate; labrum short, very broad, feebly arcuate at apex, punctate at base, with several long black setæ near the sides; antennæ one-fourth longer than the prothorax, rather slender, the fifth joint distinctly dilated, tenth slightly transverse. Prothorax fully two-thirds wider than long, the sides parallel and feebly, almost evenly arcuate throughout; base oblique and sinuate at the sides, the basal angles slightly obtuse but not rounded; apex transversely truncate, very feebly, anteriorly oblique for only a short distance at the sides, the angles slightly obtuse and blunt; disk finely, sparsely punctate, only slightly scabrous near the sides, the interspaces smooth. Elytra long, four-fifths longer than wide, one-fourth wider than the prothorax and more than three times as long, the sides parallel and nearly straight; apex evenly and almost semi-circularly rounded; humeri strongly tumid; punctures not very coarse but deep, even and well defined, rather close-set. Abdomen minutely, densely, subasperately punctulate, with very fine and short but cinereous pubescence, the legs somewhat short, densely punctulate. Length 4.7 mm.; width 1.65 mm.

California.

One of the largest and most isolated species of the genus, represented before me by a single female from an unknown part of the State. The epipleuræ are very narrow and are defined externally by the finely serrulate edge which is general throughout the genus.

5. **T. fraternus** n. sp.—Elongate, parallel, feebly convex, black, somewhat shining, slightly aenescent; legs bright rufo-ferruginous throughout; antennæ piceous-black, the funicle testaceous toward base, the basal joint black; pubescence moderately long and close on the elytra, finer and sparser anteriorly, cinereous and distinct; marginal cilia very short on the prothorax, twice as long on the elytra, even. *Head* three-fourths as wide as the prothorax, feebly convex, rather finely but closely punctato-scabrous, the frontal impressions feeble, separated by a large impunctate space; epistoma short, pale and coriaceous, the labrum long, parabolic; eyes large and moderately prominent; antennæ rather stout, moderate in length, the fifth joint feebly dilated, almost equilateral, the tenth somewhat transverse. *Prothorax* short and transverse, fully two-thirds wider than long, the sides parallel, evenly and extremely feebly arcuate from base to apex, the former broadly arcuate throughout with obtuse and rounded angles, the apex evenly and rectilinearly truncate throughout the entire width, the angles right and well marked, though blunt; disk rather finely and sparsely punctate, coarsely reto-scabrous near the sides. *Elytra* three-fourths longer than wide, scarcely visibly wider than the prothorax, parallel and perfectly straight at the sides, very obtusely rounded at apex, the humeri moderately tumid; punctures somewhat fine and close. *Abdomen* finely, densely and subasperately punctulate, finely cinereo-pubescent; femora stout. Length 3.7 mm.; width 1.3 mm.

California (San Francisco).

The description is drawn from the male, and in that sex the fifth ventral is very short, unmodified on the disk but with the apex broadly truncate and distinctly sinuate in the middle. I have not seen the female.

This species is allied to *cylindricus*, but differs in the very feebly arcuate sides of the prothorax, with conspicuous though not at all prominent apical angles, in the much longer and denser elytral pubescence and red legs. One specimen.

6. **T. cylindricus** Motsch.—Bull. Mosc., 1859, ii., p. 393; *atrus* Bland [*ater*]: Proc. Ent. Soc. Phila., III., p. 253; Lec.: Proc. Acad. Nat., Sci., Phila., 1866, p. 351 (*Pristoscelis*).

Elongate, parallel, black, the legs and antennæ black throughout; pubescence cinereous, very short though somewhat coarse and distinct, decumbent and sparse; marginal fringe short. *Head* nearly three-fourths as wide as the prothorax, punctato-scabrous; eyes large and somewhat prominent; epistoma pale and coriaceous; labrum broad, feebly arcuate at apex; antennæ rather slender, longer than the prothorax, the fifth and seventh joints only just visibly dilated, the tenth slightly transverse. *Prothorax* two-



thirds wider than long, the sides parallel, evenly and moderately arcuate, the base arcuate, with the angles somewhat distinct though obtuse and rounded; apex rectilinearly truncate, the angles slightly obtuse and distinctly rounded; disk sparsely and rather finely punctured, polished. Elytra long, fully three-fourths longer than wide; evidently, though only slightly, wider than the prothorax, parallel and straight at the sides, not very broadly rounded behind, the punctures moderately fine and well separated; interspaces slightly alutaceous. Length 3.8 mm.; width 1.4 mm.

California (San Francisco). The male type above described has very simple sexual characters, the fifth ventral being subtruncate at apex and unmodified, the genital segment large and flat, with a fine deep canaliculation along the median line.

7. **T. laticollis** Mann.—Bull. Mosc., 1843, p. 247 (Dasytes); Lec.: Proc. Acad., Phila., 1866, p. 352 (Pristoscelis).

Oblong, convex, shorter and broader than *cylindricus*, with the pubescence a little longer and denser, cinereous; body black, the upper surface with a grayish-subæneous lustre; legs and antennæ piceous-black, the latter feebly testaceous toward the base of the funicle. Head confusedly punctato-scabrous, broadly bi-impressed anteriorly, the labrum broad, feebly arcuate at apex; antennæ moderate, the tenth joint somewhat transverse. Prothorax three-fifths wider than long, the sides parallel and strongly arcuate; basal angles very broadly rounded and obliterated, the apical broadly rounded but less obliterated; apex truncate; disk finely, sparsely punctate and polished. Elytra one-half longer than wide, only slightly wider than the prothorax, parallel, very broadly and obtusely rounded at apex, the humeri somewhat acutely tumid; punctures rather fine and well separated, rugose by oblique reflection, the interspaces polished. Length 3.2–3.7 mm.; width 1.3–1.5 mm.

California (near San Francisco). Somewhat allied to *cylindricus*, but broader, with more strongly arcuate sides of the prothorax and more broadly rounded basal angles. The male differs but little from the female, having feeble sexual characters at the abdominal apex, but the prothorax is larger, although similarly proportioned and is about as wide as the elytra; the head is large in both sexes. Several other very closely allied species are indicated by material in my cabinet.

8. **T. castus** n. sp.—Elongate-oval, convex, black, polished, the upper surface with a feeble æneous lustre; legs and antennæ black, the tibiæ and tarsi feebly picescent; pubescence rather long, decumbent, cinereous, somewhat dense on the elytra, sparser anteriorly. *Head* scarcely three-fifths as wide as the prothorax, somewhat finely, sparsely punctate, slightly rugose toward base, broadly and strongly bi-impressed anteriorly, the impressions separated by a wide and elongate impunctate area; epistoma short, rectilinearly truncate, flattened; labrum broad but rather long, the apical margin very broadly parabolic, the disk with some long setæ; eyes moderately large, not very prominent; antennæ barely longer than the prothorax, rather stout, the tenth joint distinctly transverse, the fifth not distinctly dilated. *Prothorax* nearly three-fourths wider than long, widest just behind the middle, where the sides are very obtusely prominent, thence almost equally convergent and nearly straight to the apex and base, the latter very feebly arcuate and scarcely more so than the feebly arcuato-truncate apex; basal and apical angles almost equally obtuse and rounded but both tolerably defined; disk rather strongly, somewhat sparsely and unequally punctate, the punctures coarser and subasperate anteriorly and laterally; surface smooth, coarsely reto-rugose near the sides; marginal fringe rather long, dense and even. *Elytra* distinctly wider than the prothorax, about three-fourths longer than wide; narrowly parabolic at apex; humeri prominent and tumid; punctures somewhat fine and close-set, slightly rugose, the interspaces polished. *Abdomen* coarsely pubescent, the punctures fine and not very dense. Length 4.0 mm.; width 1.5 mm.

Utah.

The single specimen serving as the type is a female. *Castus* is allied to several Californian species, but is distinguishable quite readily by the form of the prothorax, and, from *cylindricus* in addition, by the very much longer and more conspicuous pubescence.

9. **T. sinuosus** n. sp.—Oblong, elongate, convex, black, polished, the upper surface with a grayish-subæneous lustre; legs and antennæ deep black throughout; pubescence moderately long and coarse, not very dense but cinereous and conspicuous. *Head* large, rather more than three-fourths as wide as the prothorax, the eyes somewhat large but only moderately prominent; punctures rather fine and sparse, gradually becoming closer and scabrous toward the sides and base; frontal impressions feeble and elongate; labrum short, broadly arcuate at apex; antennæ rather long and stout, slightly longer than the prothorax, the fifth and sixth joints subequal and both somewhat wider than the eighth, tenth strongly transverse. *Prothorax* large, about one-half wider than long, the sides parallel but deeply sinuate just behind the apical angles, and very broadly, feebly sinuate and oblique in basal half, the sides very broadly and subangularly swollen at the middle; apical angles laterally but very obtusely prominent, the basal obtuse but not rounded; apex broadly subtruncate, becoming posteriorly oblique and broadly rounded at the sides;

base broadly arcuate; marginal fringe very short; disk rather finely, sparsely punctate, coarsely scabrous toward the sides. *Elytra* barely three-fifths longer than wide and just visibly wider than the prothorax, parallel and straight at the sides, the apex subcircularly rounded; sutural angles rounded; humeri tumid; punctures rather fine and close-set, subrugose, the interspaces polished. *Abdomen* coarsely pubescent, minutely but not very densely punctulate, the legs long. Length 3.8 mm.; width 1.5 mm.

California.

This very distinct species is represented by a single male, having feeble sexual modifications at the abdominal vertex, the fifth segment being truncate and apparently very feebly sinuate toward the middle, with the surface unmodified; the genital segment is impressed along the middle as usual.

10. **T. transversus** n. sp.—Oblong, moderately convex, shining, black, the upper surface with very feeble subaneous lustre; legs black, the tibiae and tarsi piceous; antennae piceous, the basal joint black; pubescence sparse but rather long, somewhat coarse, cinereous and distinct; marginal fringe short on the prothorax, much longer on the elytra. *Head* fully three-fourths as wide as the prothorax, finely, sparsely but subasperately punctate, rugose toward base, the frontal impressions strong and separated by a sensibly elevated impunctate area; epistoma pale and coriaceous; labrum transversely arcuate at apex; eyes rather large and prominent; antennae not very stout, one-half longer than the prothorax, the fifth joint but feebly dilated, tenth strongly transverse. *Prothorax* very short and transverse, nearly twice as wide as long, the sides parallel, evenly and somewhat feebly arcuate from base to apex, the latter evenly and feebly arcuato-truncate throughout the width, the base scarcely visibly more arcuate; basal and apical angles almost equal, slightly obtuse and rounded but distinct; disk rather finely, sparsely perforato-punctate, the edges of the punctures elevated or burred, broadly scabrous toward the sides. *Elytra* three-fifths longer than wide, about equal in width to the prothorax, parallel and straight at the sides; apex broadly rounded; humeri tumid; flanks impressed toward base; punctures rather fine and moderately close-set, subrugose, the interspaces polished. *Abdomen* somewhat finely and thinly pubescent, the punctures very fine and feeble. Length 3.25 mm.; width 1.35 mm.

California (San Francisco).

The male has the fifth ventral unmodified on the disk, the apex truncate and apparently very slightly sinuate toward the middle, the genital segment broadly impressed, finely canaliculate along the middle and broadly emarginate at apex. This species is allied to several of the *cylindricus* group, but is distinguishable at once from any of them by the very short prothorax, and, from *fra-*

*ternus*, it may be known in addition by the black legs. A single specimen.

11. **T. sparsus** n. sp.—Elongate-oval, strongly convex, polished, black, the upper surface with a scarcely perceptible metallic lustre; the legs and antennæ throughout dark rufous; pubescence somewhat long and fine, closely decumbent, very sparse but cinereous and distinct. *Head* fully two-thirds as wide as the prothorax, rather convex, polished, finely, sparsely punctate, the anterior impressions large but very feeble; epistoma at apex and labrum pale, the latter broadly rounded; eyes moderately large and prominent; antennæ a little longer than the prothorax, the fifth and seventh joints very feebly dilated, the tenth transverse. *Prothorax* three-fifths wider than long, the sides feebly convergent from base to apex and feebly, evenly arcuate; basal angles broadly rounded, the apical obtuse and nearly as broadly rounded as the basal; apex truncate in the middle; base very broadly arcuato-truncate, slightly but perceptibly wider than the apex, disk finely, remotely punctate, not at all scabrous at the sides, the interspaces smooth and polished. *Elytra* two-thirds longer than wide, only very slightly wider than the prothorax, feebly inflated behind basal fourth, the sides becoming slightly arcuate; apex very broadly rounded; humeri tumid but not large; punctures very coarse, impressed and sparse. *Abdomen* rather densely clothed with short fine pubescence, the legs somewhat short. Length 3.2–3.4 mm.; width 1.25–1.4 mm.

#### Colorado.

The type is a female having the fifth ventral produced at the middle of the apex in an acute and prominent cusp, the surface feebly deflexed toward tip and very slightly impressed in the middle, with some long erect black setæ toward the sides; the genital segment is large, broadly arcuate at apex, broadly impressed and finely, deeply canaliculate along the middle.

This species and the next, of the Rocky Mountain region, differ conspicuously in general type from the Californian species which immediately precede. The side margins of the body bear a close and even fringe of moderately short setæ. In the present species the elytral punctures become much finer and distinctly closer toward apex, and the pubescence becomes correspondingly a little less sparse. Two specimens.

12. **T. ciliatus** n. sp.—Subcylindrical, polished, black, the elytra rufo-piceous, becoming darker toward base; legs bright rufo-ferruginous throughout; antennæ pale testaceous, slightly piceous at the extreme apex; pubescence rather long, moderately coarse, very sparse, cinereous and distinct. *Head* about two-thirds as wide as the prothorax, rather short, finely but strongly, remotely punctate, polished throughout and not in the least scabrous; anterior impressions very feeble, separated at apex by a large convex impunctate area;

apex of the epistoma and entire labrum bright rufo-ferruginous, the latter broadly arcuate at apex; eyes only moderately large and somewhat prominent; antennæ barely longer than the prothorax, the tenth joint strongly transverse. *Prothorax* one-half wider than long, widest at basal third, where the sides are parallel and broadly rounded, thence becoming distinctly convergent and very feebly arcuate to the apex; basal angles very broadly, the apical only a little less broadly, rounded; apex truncate and much narrower than the base; punctures fine, but strong and remote, the surface perfectly smooth, not at all rugose at the sides. *Elytra* not quite two-thirds longer than wide, slightly wider than the prothorax, parallel and nearly straight at the sides, the apex very broadly rounded; flanks longitudinally impressed toward base; humeri tumid; punctures impressed, sparse and coarse, finer and less sparse toward apex. *Abdomen* very finely and feebly punctulate and more densely pubescent. Length 3.7 mm.; width 1.4 mm.

Texas.

The single type of this species is also a female, having the fifth ventral very broad with the apex subtruncate and produced in the middle in a very broad and obtuse cuspiform projection, which is greatly obscured by the dense, stiff, blackish pubescence at the apical margin, the surface feebly deflexed and distinctly impressed in the middle toward tip, and with several long, erect, black setæ in a transverse series at each side. It is closely allied to *sparsus*, but is more elongate and cylindrical, with a somewhat less transverse prothorax differently rounded at the sides, a slightly longer fringe at the sides of the elytra, and a shorter and broader fifth ventral, with the apical cusp shorter and broader in the female. In general form it is not unlike some species of *Scolytidæ*.

13. **T. atricornis** Lec.—Proc. Acad. Nat. Sci., Phila., 1866, p. 352 (Pristoscelis).

Subcylindrical, strongly convex, polished, black, the upper surface with a dark lustre; legs bright rufo-ferruginous throughout; antennæ piceous-black, the basal joint black; epistoma and labrum piceous-brown; pubescence short, rather coarse and sparse and readily removable; fimbriæ even, short on the prothorax, longer on the elytra. Head scarcely three-fourths as wide as the prothorax, rather short, finely and somewhat feebly punctato-rugulose, the impressions feeble and widely separated; labrum large, broad, parallel, truncate at apex; eyes large but scarcely prominent, attaining the prothorax; antennæ barely as long as the prothorax, rather stout, the tenth joint strongly transverse. Pro-

thorax long, one-third wider than long, the sides evenly and distinctly convergent and very feebly, evenly arcuate from base to apex, the basal angles very obtuse but only slightly rounded, the apical less obtuse and blunt; base strongly arcuate from angle to angle; apex evenly and feebly arcuato-truncate throughout the width; disk finely but strongly, sparsely punctate, scarcely at all rugose near the sides. Elytra fully two-thirds longer than wide, not more than twice as long as the prothorax and only just visibly wider; humeri strongly swollen; punctures moderately coarse, deep, impressed, somewhat close-set and even. Abdomen minutely, densely punctulate and clothed with long and abundant cinereous pubescence, the legs rather long. Length 3.5 mm.; width 1.3 mm.

Arizona. The specimen described agrees with the original type and is a female. *Atricornis* is a very distinct species in general appearance, owing to the long and gradually narrowed prothorax, short pubescence and pale red legs.

14. **T. fulvotarsis** Bland.—Proc. Ent. Soc. Phila., III., p. 254; Lec.: Proc. Acad., Phila., 1866, p. 352 (*Pristoscelis*).

Slender, subcylindrical, shining, black, the elytra picescent; legs pale rufo-ferruginous, the femora piceous; antennæ dark piceous, the basal joint still darker; pubescence short, rather fine and moderately dense, decumbent, cinereous and distinct. Head more than three-fourths as wide as the prothorax, finely, sparsely punctate, nearly smooth; impressions elongate and feeble, remote, separated at apex by a small tumid area; epistoma and labrum short, each slightly pale at apex, the latter truncate; eyes moderately large and prominent, slightly distant from the prothorax; antennæ slender, about one-third longer than the prothorax, the fifth joint only slightly dilated, outer joints transversely ovoidal. Prothorax nearly one-half wider than long, the sides parallel, moderately arcuate, more strongly so behind the middle; angles obtuse but only slightly blunt, the basal very distinct; apex broadly, feebly arcuate, the base much more strongly so; punctures small and sparse, the surface smooth, only feebly subrugose near the sides, the marginal fimbriæ well developed, dense and even. Elytra long, four-fifths longer than wide, distinctly wider than the prothorax, parallel

evenly rounded at apex, finely, rather feebly and somewhat sparsely punctate. Legs decidedly slender. Length 2.75–3.0 mm.; width 0.9–1.0 mm.

Middle coast regions of California. This species may be known at once by its narrow and subcylindrical form, color of the legs and other characters as detailed above; it is an abundant species. The description is drawn from a female example, but the male does not differ noticeably in form and has very feeble abdominal characters.

15. **T. antennatus** Motsch.—Bull. Mosc., 1859, ii., p. 394.

Oblong-oval, strongly convex, polished, black, the upper surface with a dull æneous lustre; legs rufo-ferruginous, the femora rufo-piceous; antennæ testaceous, piceous-black toward apex, the two basal joints also blackish; pubescence moderately long, coarse, dense and cinereous, the cilia at the sides of the prothorax and elytra long and bristling and scarcely fimbriiform. Head three-fifths as wide as the prothorax, rather finely and sparsely punctate, the epistoma and labrum dark rufo-testaceous; impressions feeble. Prothorax almost evenly and transversely elliptical, two-thirds wider than long, the sides parallel and evenly, strongly arcuate; angles very obtuse and rounded; disk strongly but not very closely punctate. Elytra three-fifths longer than wide, distinctly though not greatly wider than the prothorax, parallel, very broadly rounded at apex. Abdomen finely, densely punctulate and densely pubescent. Length 2.75 mm.; width 1.15 mm.

California (San Francisco). I have scarcely any doubt that this is the true *antennatus* of Motschulsky, who states that it resembles *laticollis* Mann., but is smaller. It differs from *laticollis*, however, in having long bristling pale hairs along the sides of the body, these being short and fimbriate in that species. Some few of the hairs toward the sides of the elytra appear to be semi-erect, and the species might therefore be almost as appropriately assigned to the *fuscus* group, some of the members of which it resembles considerably. The two specimens before me are females.

16. **T. discipulus** n. sp.—Oblong-oval, strongly convex, shining, black, the upper surface slightly æneous; legs rufo-ferruginous, the femora piceous-black; antennæ dark piceous, blackish near the apex and at base; pubescence

rather short and somewhat coarse, sparse but cinereous and distinct. *Head* two-thirds as wide as the prothorax, feebly reticulate, finely, sparsely punctate, deeply impressed along the median line near the base, the anterior impressions feeble; epistoma and labrum piceous-black, short, the latter arcuato-truncate; eyes moderately large, not prominent; antennæ rather stout, distinctly incrassate and clothed with short, erect bristling setæ near the apex, the fifth joint distinctly dilated, tenth somewhat transverse. *Prothorax* transversely oval, barely one-half wider than long, the sides parallel and strongly, evenly arcuate; apex broadly arcuato-truncate, the angles rounded; base feebly arcuate, the angles very obtuse but only slightly rounded; disk coarsely reticulate, strongly so toward the apex and becoming slightly scabrous near the sides; punctures sparse, rather small; marginal cilia long. *Elytra* oblong, three-fifths longer than wide, slightly though distinctly wider than the prothorax, parallel and straight at the sides, broadly, evenly parabolic in apical third; humeral callosities rather small and narrowly rounded; punctures fine, feeble and sparse, the interspaces feebly reticulate. *Legs* moderately long, the posterior femora somewhat stout. Length 2.5 mm.; width 0.95 mm.

#### California.

The single male before me is but slightly modified at the abdominal vertex, the fifth segment being evenly truncate at tip and otherwise normal. The species is quite distinct, and will be readily known by its convex, sparsely pubescent surface, bicolored legs and other features.

**17. *T. femoralis* n. sp.**—Elongate-oval, strongly convex, shining, black, without æneous lustre, the legs rufo-ferruginous with the femora black; antennæ piceo-testaceous, the two basal and two or three apical joints slightly blackish; pubescence very short, rather coarse, sparse and cinereous. *Head* less than two-thirds as wide as the prothorax; longitudinally convex, reticulate, not medially impressed toward base, finely and sparsely punctate, the anterior impressions feeble; epistoma very short with a fine pale and coriaceous apical margin; labrum unusually small, short, pale at the margins, the apex truncate toward the middle; eyes large but not prominent; antennæ moderate in length, rather stout, the outer joints incrassate and hispid with short erect setæ, tenth decidedly transverse. *Prothorax* transversely oval, somewhat more than one-half wider than long, the sides parallel and strongly, evenly arcuate; angles obtuse and rounded; base and apex broadly arcuate, the latter slightly the less strongly so; disk reticulate, finely, sparsely punctate, more strongly so and with the surface slightly scabrous and less shining toward the sides. *Elytra* short, not quite one-half longer than wide, only slightly wider than the prothorax, gradually dehiscent behind, parallel, evenly rounded at apex, the humeri only very feebly tumid; punctures coarse, sparse, deep and impressed. *Legs* rather long, the femora polished, with the extreme tips rufous. Length 2.35 mm.; width 0.9 mm.

#### California.



This species is evidently allied to the preceding, but differs remarkably in the sculpture of the elytra, these being also very much shorter. The single male in my cabinet has the fifth ventral short and broadly truncate at apex, but otherwise unmodified. In both of these species the cilia along the sides margins of the body are rather sparse and are unusually long for this section of the genus.

18. **T. griseus** Lec.—Proc. Acad. Nat. Sci., Phila., VI., p. 169; Motsch.: Bull. Mosc., 1859, ii., p. 395 (*Dasytes*); *antennatus* Lec. nec Motsch.: l. c., 1866, p. 353 (*Pristoscelis*); *rufipes* Mots.: l. c., p. 395 (*Byturosomus*); Lec. and Horn: Class. Col. N. A., 2 ed, p. 215 (*Pristoscelis*).

Elytral pubescence whitish, very coarse, rather long, sparse and apparently entirely unmixed with erect hairs. Antennæ short, stout, serrate, longer than the prothorax, incrassate, the tenth joint only just visibly wider than long. Legs and antennæ dark rufous; posterior tarsi thick, fully as long as the tibiæ. Length 2.5 mm.; width 1.2 mm.

California (San Diego)—Cab. LeConte. I am quite uncertain as to the position of this species, since the type is not before me at present, and the published descriptions and short notes taken by me some years ago are not sufficient. According to LeConte the prothorax is gradually but strongly narrowed in front, with the sides feebly arcuate and the hind angles obtusely rounded. The elytra are coarsely punctured. The "last" ventral segment of the male [fifth?] is said to be longitudinally and broadly impressed, which is very exceptional in this genus; the sixth or genital segment is however always sulcate.

19. **T. simulans** n. sp.—Rather stout, oblong, convex, black, the legs pale rufo-ferruginous throughout; antennæ rufous, slightly obscure at the apex; pubescence rather long, very sparse but white and conspicuous. Head barely two-thirds as wide as the prothorax, convex, finely, sparsely punctate, polished and perfectly smooth throughout, the anterior impressions feeble; epistoma short with the apical margin pale and coriaceous; labrum short and broad, widely rounded; mandibles pale externally; eyes moderately large but scarcely prominent; antennæ stout, incrassate near the apex, but slightly longer than the prothorax, the fifth joint dilated as usual, tenth distinctly transverse. Prothorax short, fully two-thirds wider than long, the sides strongly convergent and almost evenly, very feebly arcuate from base to apex, the latter rectilinearly truncate and much narrower than the base, which is broadly, strongly arcuate; angles at base and apex obtuse and rounded; disk highly polished and perfectly smooth to the side margins, finely, sparsely punctate

throughout. *Elytra* one-half longer than wide, quite distinctly wider than the prothorax, parallel, broadly rounded at apex; humeri moderately tumid; punctures rather coarse but only moderately deep, feebly rugose by oblique reflection, sparse. *Abdomen* finely, somewhat densely pubescent, the legs moderately long and slender. Length 2.6 mm.; width 1.1 mm.

Texas (El Paso). Mr. Dunn.

The male, if I have correctly identified this sex by the simple but transversely truncate fifth ventral, appears to differ greatly from the usual types of the genus in having both spurs of the anterior and middle tibiae simple and slender. The left antenna of the type specimen is deformed, the third joint being very elongate, enveloping the fourth externally and extending to the base of the fifth. The four specimens before me are quite uniform in size, but some are slightly pale and piceous-brown from immaturity.

20. **T. modestus** n. sp.—Stout, oblong, convex, piceous-black, the elytra pale and castaneous, polished; legs and antennae pale rufo-ferruginous, the latter slightly obscure at the extreme tip; pubescence rather long but sparse, pale cinereous, even and distinct, closely decumbent. *Head* slightly more than three-fifths as wide as the prothorax, polished and smooth but somewhat dull and subscabrous anteriorly, where the two impressions are strongly marked; labrum piceous, broadly rounded; eyes moderate in size; antennae but slightly longer than the prothorax, incrassate toward apex, the tenth joint strongly transverse. *Prothorax* short, three-fourths wider than long, the sides evenly and strongly convergent, and almost evenly and rather feebly arcuate from base to apex; all the angles obtuse and rounded; apex truncate, much narrower than the base, the latter broadly arcuate; disk smooth, feebly reticulate near the sides, the punctures moderate and remote, becoming coarse and closer toward the sides. *Elytra* short, oblong, two-fifths longer than wide, slightly wider than the prothorax, very obtusely rounded at apex, the humeri slightly tumid; punctures moderately large, sparse. *Abdomen* finely and rather sparsely punctate, the legs decidedly slender. Length 2.5 mm.; width 1.15 mm.

Kansas.

The single male serving as the type represents a species allied in many structural generalities to *simulans*, but differing in its shorter form, in its rather feebler elytral and coarser pronotal punctures, and in the very much shorter fringe of pale hairs along the side margins of the body. The fifth ventral is simple and truncate.

21. **T. separatus** n. sp.—Subcylindrical and moderately convex, somewhat shining, brownish-black above, deep black beneath; legs pale rufo-fer-

ruginous throughout, the head piceous-black; pubescence rather fine and even, somewhat short, moderately close, brownish-cinereous in color. *Head* nearly four-fifths as wide as the prothorax, exactly equal in width to the anterior margin of the latter, finely, somewhat closely punctate and slightly rugulose, the anterior impressions rather feeble but distinctly defined by the somewhat prominent supra-antennal ridges and separated by a smooth impunctate convexity at apex; epistoma pale and coriaceous throughout; labrum almost semi-circularly rounded; mandibles pale toward base; eyes scarcely at all prominent; antennæ slender, about as long as the prothorax, not in the least incrassate toward tip, the fifth joint distinctly dilated, the tenth transverse and almost completely symmetrical. *Prothorax* long, not quite one-third wider than long, widest at basal third where the sides are very feebly prominent, thence distinctly convergent and almost straight to the apex and feebly so for a very short distance to the basal angles, which are extremely obtuse but scarcely at all rounded; apical angles obtuse and rounded; apex arcuato-truncate, the base broadly arcuate; disk minutely, sparsely punctate, only slightly rugulose near the sides, marginal fringe short and close. *Elytra* three-fifths longer than wide, nearly one-third wider than the prothorax, parallel and nearly straight at the sides, very obtusely rounded at apex, the humeri narrowly rounded and slightly tumid; punctures rather fine but distinct and somewhat close-set. *Abdomen* finely and not very densely cinereo-pubescent, the legs very slender, the femora finely and closely punctulate. Length 2.5 mm.; width 1.0 mm.

California (San Mateo).

A distinct species, identifiable at once by the elongate and apically narrowed prothorax which is much narrower than the elytra, brownish pubescence and slender red legs. The single specimen before me is not obviously determinable in regard to sex.

22. **T. pudens** n. sp.—Narrowly oblong, somewhat convex, moderately shining, black, the legs and antennæ pale rufo-ferruginous, the last joint of the latter somewhat obscure; integuments feebly reticulate throughout, becoming subrugose toward the sides of the prothorax; pubescence rather fine and sparse anteriorly but very coarse and somewhat dense, pale ochreo-cinereous and closely decumbent on the elytra. *Head* rather small, scarcely more than three-fifths as wide as the prothorax, rugulose toward base but very minutely and almost imperceptibly punctate throughout, the anterior impressions large and strong, the median convex surface large and smooth; epistoma piceous and subcoriaceous; labrum short, pale, almost semi-circularly rounded; eyes not very large and somewhat prominent; antennæ very slender, scarcely longer than the prothorax, the first two joints much stouter, fifth distinctly dilated, last three rather abruptly larger and incrassate among themselves, the tenth transverse. *Prothorax* one-half wider than long, widest at basal third where the sides are parallel and broadly arcuate, becoming gradually rather strongly convergent and very feebly arcuate anteriorly to the obtuse but evi-

dent apical angles; basal angles very broadly rounded, the base arcuate; apex subtruncate; disk sparsely and very minutely punctate. *Elytra* scarcely more than one-half longer than wide, nearly one-third wider than prothorax, parallel and straight at the sides, very obtusely rounded at apex, the humeri only slightly tumid; punctures fine and rather close-set. *Abdomen* more polished, finely punctulate and finely pubescent, the legs slender. Length 2.0 mm.; width 0.75 mm.

Arizona (Benson). Mr. Dunn.

The four specimens before me are perfectly uniform, and are apparently females. The species is quite distinct because of its small size, feeble punctures and very coarse elytral pubescence, as well as in antennal structure.

23. **T. indigenus** n. sp.—Narrow, parallel, strongly convex, highly polished, black, the upper surface with a dull subæneous lustre; legs pale rufo-ferruginous throughout; antennæ dark testaceous, gradually piceous-black beyond the middle; pubescence cinereous, moderate in length, rather abundant and conspicuous though not very coarse. *Head* two-thirds as wide as the prothorax, polished, finely, sparsely punctate, the frontal impressions small and very feeble; labrum small, rounded; mandibles pale except toward apex; eyes moderately large and not very prominent; antennæ one-third longer than the prothorax, rather slender and distinctly serrate internally throughout, the outer three joints but slightly wider, fifth distinctly dilated, tenth slightly transverse and asymmetric, the inner apical angle more prominent, joints with tufts of short erect setæ within. *Prothorax* three-fifths wider than long, the sides parallel and broadly, strongly arcuate, becoming more convergent and straighter in about apical third; angles obtuse; apex arcuato-truncate, slightly narrower than the base; disk strongly convex, finely, sparsely punctate. *Elytra* three-fifths longer than wide, fully one-fourth wider than the prothorax, parallel, obtuse at apex, the humeral callosities small and feeble; punctures somewhat fine but strong, rather close-set. *Abdomen* finely pubescent, the legs slender. Length 2.1–2.3 mm.; width 0.75–0.85 mm.

California (Sta. Clara Co.).

The description is drawn from the male, and in that sex the fifth ventral is truncate at apex, with the punctures denser in the middle toward base, the fourth with a few stiffer spiniform setæ in a cluster at the middle near the apex, and the genital segment is broadly emarginate and medially impresso-canaliculate as usual. The female scarcely differs at all, being merely a little stouter, with a just visibly smaller head. Five specimens.

24. **T. incipiens** n. sp.—Oblong-oval, dilated behind, feebly convex, rather dull, the elytra shining, black, the elytra with a feeble subæneous lustre; legs rufo-testaceous, the femora picescent; antennæ testaceous, the last three joints feebly dilated and gradually blackish; pubescence rather short and

fine, cinereous and sparse. *Head* scarcely three-fifths as wide as the prothorax rather finely but strongly, densely punctate, subimpunctate in the middle anteriorly, the impressions large and deep; apex of the epistoma thin and coriaceous; labrum short, pale, broadly arcuato-truncate at apex; mandibles and palpi pale, dark toward apex; eyes not very prominent; antennæ slender, the fifth and seventh joints strongly dilated, tenth wider than long. *Prothorax* fully three-fourths wider than long, widest at basal third; sides strongly convergent anteriorly, becoming parallel and broadly rounded toward base; apex arcuato-truncate, much narrower than the base, which is more strongly arcuate; disk finely, unevenly and densely punctate, becoming coarsely reticulate near the sides; lateral margins finely subserrulate toward base, the cilia rather long. *Elytra* one-half longer than wide, widest at posterior third, where they are nearly two-fifths wider than the prothorax; sides arcuate, becoming parallel for a short distance at base; apex very broadly rounded; punctures fine, feeble and sparse, the interspaces obsoletely reticulate. *Abdomen* finely but strongly and densely punctate, finely, rather thinly pubescent, the legs short. Length 2.3 mm.; width 1.1 mm.

Arizona (near the Grand Cañon of the Colorado). Dr. T. Mitchell Prudden.

The single type is a female, and the species makes a remarkable approach to *Listrus* in general organization, but the anterior tibiae have two well developed external series of stiff erect spines. The fifth ventral is broadly and very evenly rounded at apex.

25. **T. erythropus** Lec.—Proc. Acad. Nat. Sci., Phila., VI., p. 170 (*Dasytes*); l. c. 1866, p. 353 (*Pristoscelis*).

Oblong-oval, moderately convex, black, dull, the elytra only feebly shining; legs pale rufous, the tibiae and tarsi blackish; antennæ testaceous, only slightly obscure toward apex, the basal joint blackish; palpi and labrum piceous-black; pubescence very coarse on the elytra, moderately long and somewhat dense, cinereous. Head two-thirds as wide as the prothorax, finely, densely punctate, the impressions rather feeble; eyes moderately large and somewhat prominent; epistoma somewhat pale and coriaceous; antennæ short, scarcely longer than the prothorax, the three outer joints rather strongly dilated, the tenth strongly transverse. Prothorax three-fifths wider than long, the sides sensibly convergent from base to apex, feebly and almost evenly arcuate, the basal angles very broadly obtuse and rounded; disk opaque, finely, unevenly and very densely but not profoundly punctate, only slightly more scabrous toward the sides; marginal cilia short, dense and evenly recurved. Elytra nearly three-fifths

longer than wide, only very slightly wider than the prothorax, scarcely sensibly dilated behind, broadly parabolic at apex, finely but somewhat strongly and moderately densely punctate. Length 2.25–2.4 mm.; width 0.9–1.0 mm.

Texas. The above outline is taken from the female, in which sex the fifth ventral is rather strongly rounded at apex; but the male does not greatly differ, having the head distinctly, and the prothorax slightly larger, with the fifth ventral short and broadly sinuato-truncate at apex, and the genital segment broadly impresso-canaliculate along the middle, with the apex apparently arcuato-truncate. This species also resembles *Listrus*, and has the tibial spines rather feebler than in *incipiens*, but the structural characters place it in *Trichochrous* without doubt; it is recognizable at once by the coloration of the legs.

26. **T. convergens** Lec.—Proc. Acad. Nat. Sci., Phila., 1866, p. 352 (*Pristoscelis*).

Elongate-oval, strongly convex, feebly shining, grayish-black, the elytra broadly pale flavo-testaceous at the lateral and apical margins; legs, antennæ and oral organs, epistoma and labrum pale rufo-ferruginous, the mandibles and palpi slightly obscure at tip and the eleventh antennal joint somewhat darker; pubescence moderately long, decumbent, pale luteo-cinereous and very coarse, rather sparse anteriorly but dense on the elytra, though not concealing the surface. Head three-fourths as wide as the prothorax, the eyes large and prominent; punctures rather fine and sparse, the interspaces smooth; pubescence conspicuous; antennæ about as long as the prothorax, rather stout but scarcely incrassate, compact, the outer joints strongly transverse, fifth only very feebly dilated. Prothorax two-fifths wider than long, subparallel and broadly rounded but with the sides convergent and straight toward apex, the latter arcuate and much narrower than the base; disk finely and obsoletely granulato-reticulate, finely and sparsely punctate, the sculpture if anything not as strong toward the sides as in the middle. Elytra two-thirds longer than wide, only slightly more than twice as long as the prothorax and, at base, distinctly wider; sides apparently very slightly convergent from base to apex, straight; apex evenly rounded; punctures not very coarse but strong and rather close-set. Length 3.3 mm.; width 1.2 mm.

Arizona. The above description refers to the male, in which, in addition, the fifth ventral is truncate at apex and paler in color. This is a very distinct species both in coloration and structure.

27. **T. innocens** n. sp.—Narrow, subparallel, convex, polished, black, the elytra with a feeble greenish-aneous lustre; legs rufo-piceous, the tibiae and tarsi quite pale; antennae deep black, with joints three to five slightly paler; pubescence short, rather coarse and sparse, pale fulvous; elytra with the extreme apex rufo-ferruginous. *Head* four-fifths as wide as the prothorax, finely, sparsely punctate, feebly rugulose except in the middle anteriorly, the impressions rather strong and better defined by the somewhat prominent supra-antennal ridges; epistomal margin polished and depressed but black; labrum only slightly pale at the extreme apex, broadly rounded, with a few setiferous punctures along the basal margin; eyes slightly prominent; antennae rather stout, hispid throughout with erect cinereous setae, nearly one-half longer than the prothorax, fifth joint distinctly dilated, the tenth slightly wider than long, and somewhat asymmetric. *Prothorax* one-half wider than long, widest a little behind the middle, where the upper flanks are slightly tumid; sides parallel and broadly arcuate, becoming gradually convergent and nearly straight in about apical half; apex arcuato-truncate, about as wide as the base; disk finely, sparsely punctate, very obsoletely rugulose but polished, coarsely retorugose at the sides. *Elytra* oblong, two-thirds longer than wide, distinctly wider than the prothorax, slightly dehiscent at apex as usual, parallel, broadly rounded behind, somewhat finely and sparsely but distinctly punctate. *Abdomen* smooth and polished, very minutely and sparsely punctulate, thinly and finely pubescent, the legs rather slender. Length 2.25–2.7 mm; width 0.8–0.95 mm.

California (Calaveras Co.) Dr. F. E. Blaisdell.

A small but distinct species, the male described above having the fifth ventral broadly and just visibly sinuato-truncate at tip but otherwise unmodified. It may be known at once by its sparse fulvous vestiture and coloration.

Two of the three specimens before me, represented by the larger measurements, are blacker and duller, with the vestiture more cinereous, but I have but little doubt that they belong to the same species.

28. **T. apicalis** n. sp.—Stout, oblong-oval, convex, feebly shining, black, the elytra pale testaceous at apex, the pale area extending slightly along the suture and narrowly along the side margins nearly to the middle; legs rufo-ferruginous throughout; antennae dark piceo-rufous, the two basal joints slightly darker; pubescence short, coarse, closely decumbent and dense, pale luteo-cinereous in color. *Head* small, not much more than one-half as wide as the prothorax, finely, sparsely punctate, with smooth interspaces throughout; anterior impressions extremely feeble, the supra-antennal ridges wholly

obsolete; epistoma with a very narrow pale apical margin; labrum small, rounded; eyes very large, attaining the base but not prominent; antennæ short, about as long as the prothorax, the three outer joints somewhat abruptly wider, the tenth strongly transverse, fifth but slightly dilated. *Prothorax* transversely oval, about twice as wide as long, the sides subparallel and strongly, evenly arcuate, only just visibly more convergent toward apex than base; angles very obtusely rounded; disk minutely, sparsely punctate, more coarsely, densely and rugosely so at the sides; interspaces smooth. *Elytra* short, oblong, not quite one-half longer than wide, slightly but distinctly wider than the prothorax, parallel and straight at the sides, almost semi-circularly rounded at apex, rather finely but strongly and quite densely punctate. *Legs* short. Length 2.2 mm.; width 0.95–1.0 mm.

Southern California.

The description is drawn from the female, the male having the head two-thirds as wide as the prothorax and the latter about one-half wider than long but perceptibly narrower than the elytra; otherwise the two sexes are nearly alike. The fifth ventral of the male is transversely truncate, and of the female rather strongly rounded at apex, and, in the former, the under surface of the tip of the dorsal pygidium, projecting behind, is flat, short, transversely arcuate and sparingly pubescent. A single pair.

29. **T. egenus** n. sp.—Oblong, rather convex, moderately shining, pale rufo-testaceous, the head toward base, metasternum and apices of the ventral segments blackish; elytra black, pale at apex, along the sides and on the suture nearly to the base; legs pale testaceous; antennæ piceous; pubescence rather short, fine and sparse, luteo-cinereous and moderately distinct. *Head* scarcely more than two-thirds as wide as the prothorax, strongly and longitudinally convex, rather coarsely but not densely punctate, the anterior impressions small and somewhat distinct; labrum small and rounded; eyes decidedly small, at a slight distance from the prothorax and scarcely at all prominent; antennæ slender, longer than the prothorax, the fifth joint not wider than the sixth, tenth slightly wider than long. *Prothorax* nearly three-fourths wider than long, the sides parallel and feebly but perfectly evenly arcuate from base to apex, the four angles nearly right and scarcely at all rounded from above; apex and base almost equally arcuate-truncate; disk coarsely, rather closely and subrugosely punctate, the side-margins but feebly defined. *Elytra* three-fifths longer than wide, nearly one-third wider than the prothorax, the sides parallel and straight; apex very obtusely and broadly rounded; disk finely and somewhat sparsely punctate, the interspaces finely and obsoletely reticulate. *Abdomen* finely, feebly and subrugosely punctulate, very finely and thinly pubescent, the legs moderately long and very slender. Length 2.2 mm.; width 0.8 mm.

Utah (southwestern). Mr. C. J. Weidt.



The unique type of this remarkable species is a female, having the fifth ventral evenly and circularly arcuate at apex. It can be recognized at once by the rectangularly parallelogramic form of the prothorax.

30. **T. umbratus** Lec.—Proc. Acad. Nat. Sci., Phila., 1866, p. 352 (Pristoscelis).

Oblong, rather stout and feebly convex, shining, black, the elytra pale ochreo-flavate, with a large triangular sutural spot at the base of piceous-black; abdomen pale, gradually obscure toward base; legs and oral organs very pale ochreous; antennæ dark piceo-rufous; pubescence moderately fine and sparse, rather long, suberect on the elytra; marginal cilia somewhat long. Head three-fourths as wide as the prothorax, finely, sparsely punctate, the impressions distinct and widely separated; epistoma unusually long and narrow, flavate; labrum long, parabolic; mandibles long, pale, obscure at tip; eyes moderate in size and not prominent; antennæ distinctly longer than the prothorax, somewhat slender, the tenth joint distinctly wider than long, fifth dilated. Prothorax two-fifths wider than long, the sides subparallel, evenly and very feebly arcuate from base to apex, only very slightly more convergent anteriorly; angles obtuse; disk finely and sparsely punctate. Elytra oblong, not quite one-half longer than wide, nearly one-half wider than the prothorax, dehiscent very near the apex, the latter very broadly and obtusely rounded; sides straight and parallel; humeri right, rounded, distinctly exposed at base; punctures rather fine but distinct and sparse. Abdomen finely, somewhat closely punctulate, finely and thinly pubescent, the legs rather long, slender. Length 2.2–2.4 mm.; width 0.9–1.0 mm.

California. Both of the specimens before me are females, the fifth ventral being broadly and feebly arcuate at apex and the genital segment deeply excavated in the middle. The second specimen agrees with the first in its long mandibles and labrum, but the gelatino-membranous epistoma is wide and distorted, showing that but little reliance can be placed upon the form of this part when it has this soft consistence. In these specimens both the spurs of the anterior and middle tibiae are slender.

I have before me a third female from another locality, similarly colored but narrower, with the sides of the prothorax gradu-

ally convergent from the base, and with short mandibles and labrum; it probably represents a closely allied species.

31. **T. nubilatus** n. sp.—Rather narrow and convex, polished, black, the prothorax with a feeble æneous lustre; elytra pale rufo-ferruginous, with a large and indefinite sutural cloud of blackish in about basal half; abdomen black, the fifth segment and following pale; legs pale rufous throughout; antennæ black, the funicle feebly testaceous toward base; pubescence moderately long, dense and coarse, pale luteo-cinereous in color. *Head* nearly four-fifths as wide as the prothorax, finely, sparsely punctate, the frontal impressions feeble; epistoma short, depressed and thin but black and corneous; labrum semi-circular, with a few small scattered setigerous punctures; mandibles rather long, pale, black at tip; eyes large and somewhat prominent; antennæ nearly two-fifths longer than the prothorax, bristling with short stiff setæ especially within, the fifth joint dilated, tenth slightly transverse and somewhat asymmetric. *Prothorax* two-fifths wider than long, the sides evenly and feebly convergent from base to apex and evenly, feebly arcuate; basal angles broadly rounded, the apical obtuse and greatly deflexed; apex arcuato-truncate and distinctly narrower than the base; disk polished, obsoletely reticulate, not scabrous laterally, finely and sparsely punctate. *Elytra* one-half longer than wide, fully two-fifths wider than the prothorax, parallel and straight at the sides, broadly rounded at apex; humeri slightly exposed at base; disk finely, rather densely and not very distinctly punctate. *Legs* somewhat long and slender. Length 2.3 mm.; width 0.8 mm.

California (Lake Co.).

The unique type of this species is a male and has the fifth ventral rectilinearly truncate at apex, with the surface polished and almost impunctate save a few piliferous punctures in the middle toward base; the genital segment is large, flat, truncate at apex, the latter with a beveled coriaceous edge, the surface feebly divided along the median line; the fourth segment, and, to a less degree the third, has a cluster of coarse punctures in the middle toward apex, which bear short pointed spiniform and inclined setæ which radiate in direction from the median line. This species is readily distinguishable from *umbratus* by its dense and coarse vesiture and nubilate maculation.

32. **T. suffusus** n. sp.—Moderately stout and convex, shining, black, the elytra pale luteo-testaceous, broadly and suffusedly black toward the suture except toward apex; abdomen with only the extreme apex of the fifth segment pale; legs pale rufous throughout; antennæ dark piceo-rufous; pubescence rather fine, moderately long and sparse, cinereous, the scutellum thinly pubescent. *Head* two-thirds as wide as the prothorax, finely, sparsely punctate, the impressions large and feeble; epistoma very short and broad, with a

very narrow and thin pale apical margin; labrum semi-circular; eyes rather large but scarcely at all prominent; antennæ somewhat stout, distinctly longer than the prothorax, the tenth joint transverse, fifth dilated. *Prothorax* nearly one-half wider than long, the sides broadly rounded and subparallel, becoming distinctly convergent toward apex, the basal angles broadly rounded, apical obtusely rounded and deflexed; apex arcuato-truncate, not narrower than the base, the marginal cilia very short; disk finely, sparsely punctate, only very feebly subrugulose near the sides. *Elytra* oblong, one-half longer than wide, two-fifths wider than the prothorax, parallel and straight at the sides, gradually dehiscent toward apex, the latter broadly obtuse; humeri but slightly tumid, somewhat exposed at base; disk finely and somewhat feebly, sparsely punctate. *Abdomen* finely punctulate, rather thinly but coarsely pubescent, the legs long and slender. Length 1.9 mm.; width 0.75 mm.

California (Sta. Barbara.)

The male serving as the type has the fifth ventral broadly sinuato-truncate at apex and very broadly, obsoletely impressed toward the middle, and the third and fourth segments have a few diverging spinules at the middle. Two specimens.

This is one of the smallest species of the genus, and can be readily separated from *nubilatus* by the characters given in the table.

33. **T. propinquus** n. sp.—Narrow, elongate and rather strongly convex, polished, black, the prothorax with a pronounced æneous lustre; elytra pale fulvous; abdomen pale, gradually blackish toward base; legs pale luteo-testaceous throughout; antennæ rufo-testaceous, obscure toward tip; pubescence short and sparse, rather fine, fulvous in color. *Head* two-thirds as wide as the prothorax, feebly rugulose and finely, sparsely punctate, the upper surface flat, the impressions small, apical, distinct, but widely separated; epistoma very short and broad, the truncate apex not distinctly thinned or modified; labrum small, rounded; mandibles and palpi pale, dusky at tip; antennæ slender throughout, nearly one-third longer than the prothorax, sparsely setose, the tenth joint moderately transverse, the fifth scarcely dilated; eyes well developed, only slightly prominent. *Prothorax* one-half wider than long, the sides parallel and broadly arcuate; all the angles obtuse, but somewhat obvious; apex arcuato-truncate and equal to the base; marginal fimbriæ short and rather sparse; disk obsoletely reticulate, only very feebly rugulose near the sides, finely and sparsely punctate. Scutellum black. *Elytra* three-fifths longer than wide and about three-fifths wider than the prothorax, parallel and slightly arcuate at the sides except near the base, obtusely parabolic at apex, the sutural angles rounded; humeri well exposed at base; disk somewhat coarsely and strongly punctate, the punctures impressed and well separated. *Abdomen* finely and somewhat thinly cinereo-pubescent, the legs slender. Length 2.1 mm.; width 0.8 mm.

California (Los Angeles Co.). Mr. H. C. Fall.

A distinct species, represented in my cabinet by a single female, having the fifth ventral very broadly and feebly though evenly arcuate at apex, and the genital segment broadly arcuate at tip and broadly impresso-canaliculate along the middle.

34. **T. fulvovestitus** n. sp.—Somewhat stout and strongly convex, polished, black, the anterior parts with a strong æneous lustre; elytra pale fulvous, sometimes with a very feeble blackish cloud on the suture toward base; abdomen black throughout, the genital segment alone paler; legs very pale; antennæ rufo-testaceous, the eleventh joint dusky; oral organs and mandibles rufescent; pubescence rather long and coarse, dense, fulvous and conspicuous. *Head* only just visibly narrower than the prothorax, constricted at base, the front flat, finely, sparsely punctate, the impressions very feeble, a median convexity at apex smooth and polished; epistoma with a wide pale and thin coriaceous margin; labrum small, strongly rounded; eyes small, prominent and at their own length from the base; antennæ slender, one-half longer than the prothorax, the eleventh joint as long as wide. *Prothorax* nearly one-half wider than long, the sides parallel, more rounded at the middle, feebly convergent and nearly straight thence to the base and apex, the latter broadly arcuato-truncate and as wide as the base; angles rather obtuse; disk highly polished, finely and sparsely punctate. *Scutellum* black, thinly albido-pubescent. *Elytra* barely one-half longer than wide, nearly one-half wider than the prothorax, parallel and straight at the sides; the apex very broadly obtuse, the sutural angles right and not distinctly rounded; humeri rather widely exposed at base; disk somewhat finely but strongly and closely punctate. *Abdomen* finely punctulate, more or less thinly cinereo-pubescent, the legs slender. Length 2.2–2.4 mm.; width 0.8–0.9 mm.

Arizona (Yuma). Mr. G. W. Dunn.

This species is very distinct in appearance because of its large head, with the eyes small and distant from the prothorax. It is evidently allied rather closely to *propinquus*, which is known at present only by the female, but differs in the dense and conspicuous pubescence of the pronotum and black abdomen. The sexual characters of the male are very simple, the fifth ventral being truncate at apex, and the third and fourth segments completely devoid of modified pubescence. Two males.

35. **T. exiguus** n. sp.—Oblong, somewhat stout and convex, moderately shining, pale luteo-testaceous, the sterna of the hind body, abdomen, scutellum and a large cloud toward the base of the head black; legs and antennæ pale testaceous, the latter very feebly clouded near the apex; pubescence rather long and dense, closely decumbent, cinereous, very coarse on the elytra, rather fine anteriorly. *Head* large, only slightly narrower than the prothorax, strongly reticulate, very minutely, sparsely punctate, the impressions large and feeble; epistoma short; labrum short, broadly arcuato-truncate; antennæ

slightly longer than the prothorax, the three last joints distinctly broader, the tenth strongly transverse; eyes moderately large, prominent, at about one-half their length from the base. *Prothorax* one-half wider than long, widest and rather prominently rounded at the sides just behind the middle; angles obtuse; apex truncate in the middle, broadly and posteriorly oblique and rounded laterally, and fully as wide as the base or rather wider; disk very finely, sparsely punctate, slightly rugose toward the sides. *Elytra* short, two-fifths longer than wide and about two-fifths wider than the prothorax, parallel and straight at the sides, very broadly and obtusely rounded at apex; humeri rounded and quite distinctly exposed at base; punctures fine and rather dense. *Abdomen* distinctly but not very densely cinereo-pubescent, the legs slender. Length 1.8 mm.; width 0.75 mm.

#### Arizona.

The male has the fifth ventral truncate at apex, the genital segment with a broad cuspiform apical emargination and broadly impresso-canaliculate along the middle. The description applies to the unique male type. The left antennæ of the type has the fifth and sixth joints completely fused, with the division represented only by lateral notches; antennal malformations appear to be very common in this genus.

I have before me a single female, also from Arizona, having similar coloration, except that the abdomen is entirely red, and differing especially in its shorter and finer elytral pubescence and very much more elongate epistoma; it seems to represent a distinct species which it is not advisable to describe at present, in view of the peculiar sexual differences in the following species.

36. **T. testaceus** n. sp.—Oblong, convex, shining, pale luteo-testaceous throughout above and beneath; scutellum, legs and antennæ concolorous, the extreme tip of the eleventh joint of the latter blackish; eyes black; pubescence rather long, moderately sparse, decumbent, ashy and conspicuous although not very coarse, rather unevenly disposed on the pronotum. *Head* scarcely three-fourths as wide as the prothorax, coarsely and somewhat closely punctate, the interspaces smooth and polished, a convex median area toward apex impunctate; impressions extremely feeble; epistoma rather long, a wide apical margin yellow and subcoriaceous; labrum small, arcuate at tip; eyes moderately large, very near the base and only slightly prominent; antennæ distinctly longer than the prothorax, the tenth joint transverse, fifth dilated. *Prothorax* subconical, not more than two-fifths wider than long, the sides rather strongly convergent and very feebly arcuate from base to apex; angles very obtuse; apex much narrower than the base; punctures not very fine or sparse and somewhat unevenly distributed; pubescence conspicuous. *Elytra* one-half longer than wide, two-fifths wider than the prothorax, parallel and nearly straight at the sides, very obtusely and somewhat individually rounded

at apex; humeri rather narrowly exposed at base; punctures not very fine and strong, somewhat sparse. *Legs* slender. Length 1.8–2.0 mm.; width 0.65–0.8 mm.

Southern California. Mr. Wickham.

The male above described has the fifth ventral transversely truncate at apex, the disk impunctate and polished toward apex and with a few slender black hairs in the middle toward base, the third with a small subapical and the fourth with a large median patch of stout black spinules radiating from the median line. The female has the body more slender than the male, with finer pubescence, less transverse prothorax and still smaller head, the fifth ventral broadly and feebly arcuate at apex, and the abdomen evenly cinereo-pubescent throughout. Three specimens.

37. ***T. fallax*** n. sp.—Elongate, subparallel, moderately convex, polished, black with a slight æneo-piceous tinge; legs black, the tibiae except near the base and the tarsi piceous-brown; antennae piceous-black, the first and eleventh joints black; pubescence rather long, subdecumbent, equal and without erect setae, consisting on the pronotum and elytra of brown and cinereous hairs confusedly intermingled, moderately coarse and not very dense. *Head* nearly four-fifths as wide as the prothorax, strongly but sparsely punctate, feebly rugulose toward base, the impressions strong and widely separated by the impunctate convexity, the supra-antennal ridges rather pronounced; epistoma very short, not at all pale or coriaceous; labrum pale at apex, short and broad, circularly rounded; mandibles pale in the middle; eyes large, only moderately prominent, extending to the base; antennae distinctly longer than the prothorax, gradually incrassate, the outer joints clothed densely and uniformly with fine short erect cinereous pubescence and also with a few long setae, the fifth joint much wider than the fourth, but subequal to the sixth, tenth transverse and almost symmetrical. *Prothorax* one-half wider than long, the sides almost straight and parallel from the apex to basal two-fifths, then convergent and straight to the basal angles which are very obtuse but not rounded; apex rectilinearly truncate throughout, much wider than the base, the angles right and only slightly rounded; disk finely but strongly, sparsely perforato-punctate, coarsely reto-rugose but shining toward the sides, the punctures larger and with elevated edges toward apex; interspaces even and polished; marginal fringe composed of long blackish hairs. *Elytra* two-thirds longer than wide, slightly wider than the prothorax, parallel, obtusely parabolic at apex, broadly sinuate at base, rather finely and somewhat sparsely punctate, the marginal fringe composed of rather long even piceous and not very close-set hairs. *Abdomen* and legs rather densely cinereo-pubescent. Length 3.4 mm.; width 1.25 mm.

California (Sonoma Co.)

The male, which is the only sex known to me, has the fifth ventral short, only slightly longer than the fourth and broadly sinuate toward the middle at apex with the disk unmodified, and the genital segment broadly emarginate and broadly impresso-canaliculate along the middle, the under part of the dorsal pygidium large and densely bristling with short black hairs at apex.

38. **T. inæqualis** n. sp.—Parallel, moderately narrow, convex, polished, black, the elytra finely rugulose, alutaceous and with a very feeble æneopiceous tinge; legs and antennæ red, the eleventh joint of the latter dusky; pubescence even in length, without trace of intermixed setæ, rather coarse and sparse, suberect, dark near the elytral suture; marginal fringe of the pronotum dense, even and very short, of the elytra longer and cinereous. *Head* about two-thirds as wide as the prothorax, rather coarsely but not densely punctate, the interspaces smooth; anterior impressions very broad and feeble; epistoma with only a very fine pale apical border; labrum very short and broad, feebly arcuate at apex; eyes rather large and prominent, attaining the base; antennæ short, barely longer than the prothorax, rather broad and strongly compressed, the tenth joint strongly transverse and wider than the eleventh, fifth very feebly dilated. *Prothorax* two-thirds wider than long, the sides subparallel, evenly and strongly arcuate; all the angles obtuse and rounded but traceable; apex just visibly narrower than the base; punctures sparse, not very coarse but widely impressed; interspaces smooth and polished, not in the least rugose at the sides. *Elytra* barely one-half longer than wide, not distinctly wider than the prothorax, parallel, obtusely rounded behind, broadly sinuate at base, sparsely and quite coarsely punctate. *Abdomen* finely and somewhat densely cinereo-pubescent. Length 2.6–2.8 mm.; width 0.9–1.1 mm.

Colorado.

The male serving for the type has the fifth ventral broadly truncate at apex, the adjacent edge feebly inflexed and subimpunctate but with the disk otherwise unmodified. Three males.

39. **T. subcalvus** n. sp.—Oblong, convex, highly polished and black throughout; legs black, the tibiae and tarsi piceo-rufous, the former dusky toward base; antennæ black, the funicle scarcely visibly picescent toward base; pubescence rather fine, short and sparse, subdecumbent, cinereous, the hairs blackish on the pronotum except near the sides, and in a broad subsutural stripe on each elytron; marginal cilia of the pronotum even, dense, somewhat long and in great part blackish in color, of the elytra longer, sparser and more cinereous. *Head* three-fifths as wide as the prothorax, finely, sparsely punctate, the interspaces smooth, rugulose toward the sides, the impressions very large, broadly impressed; epistoma rather long but wide, truncate, black; labrum broad, circularly rounded, slightly pale near the apex; eyes rather large and prominent; antennæ but little longer than the prothorax, somewhat slen-

der, slightly incrassate through the last four joints, the tenth moderately transverse, fifth scarcely visibly dilated. *Prothorax* three-fourths wider than long, the sides subparallel, strongly and almost evenly arcuate, the apex rectilinearly truncate and but little narrower than the base; angles obtuse; disk finely, sparsely punctate, coarsely reto-rugose toward the sides; punctures not impressed, the interspaces smooth. *Elytra* one-half longer than wide, only just visibly wider than the prothorax, parallel, obtusely rounded at apex, sparsely and coarsely punctate, the interspaces polished; subscutellar umbones rather marked. *Abdomen* minutely, densely punctulate, very finely dusky-pubescent. Length 3.0 mm.; width 1.2 mm.

California (San Diego). Mr. Dunn.

This species can be readily distinguished from the last by its larger size and unimpressed pronotal punctures. It is represented in my cabinet by two female specimens which are mutually similar in size and vestiture.

40. **T. funebris** n. sp.—Oblong-oval, strongly convex, moderately stout, shining, black, without metallic lustre; legs black, the tibiae and tarsi rufo-picescent; antennae dark rufo-piceous, gradually blackish toward apex, the basal joint darker; pubescence moderately dense, fine, reclined, blackish in color, gradually coarser and cinereous toward the sides of the pronotum and on the elytra along the suture and toward the sides especially toward base, the whitish hairs extending somewhat inward at basal two-fifths; marginal cilia forming a short dense and coarse fringe on both the prothorax and elytra. *Head* three-fourths as wide as the prothorax, strongly and rather closely punctate, the impressions feeble; epistoma somewhat narrowly trapezoidal, rapidly thinned toward apex, the labrum strongly rounded and moderately elongate; eyes not very large or prominent, extending almost to the base; antennae long and slender, much longer than the prothorax, the penultimate joints rather longer than wide, fifth scarcely dilated. *Prothorax* two-thirds wider than long, the sides arcuate, more strongly so behind, more convergent anteriorly, the apex perceptibly narrower than the base; angles obtuse; disk strongly and rather closely punctate, strongly reto-rugose toward the sides; interspaces nearly smooth in the middle. *Elytra* nearly two-thirds longer than wide, quite distinctly wider than the prothorax, parallel, the apex evenly, but rather broadly parabolic; punctures moderately sparse and rather coarse, the interspaces very obsoletely and unevenly rugulose, but strongly shining. *Abdomen* and legs densely clothed with short coarse and pale fulvo-cinereous hairs. Length 3.0–3.2 mm.; width 1.2–1.3 mm.

Colorado (Rocky Mountains).

The type is a female but with rather distinct sexual characters, the fifth ventral being strongly rounded at apex and clothed with pubescence which is black and not pale as it is on the four preceding segments. Two specimens.



41. **T. vittiger** n. sp.—Oblong-oval, strongly convex, polished, black, the legs red throughout; antennæ testaceous, gradually dusky beyond the middle; pubescence rather long, even in length, suberect, fine, sparse and cinereous, brownish or blackish in a subsutural vitta on each elytron not attaining the apex and sometimes almost obliterated; marginal cilia dense and fimbriiform. *Head* about two-thirds as wide as the prothorax, finely, sparsely punctate, the interspaces smooth and polished throughout; anterior impressions very feeble, the median impunctate convexity behind the epistoma conspicuous; epistoma large, pale; labrum pale, rounded; eyes rather small and but slightly prominent, not attaining the base; antennæ stout, moderate in length, the tenth joint strongly transverse, fifth dilated. *Prothorax* fully three-fifths wider than long, the sides convergent, feebly and evenly arcuate from base to apex, the latter truncate and much narrower than the base, the latter broadly and distinctly arcuate; disk finely, sparsely punctate, the interspaces smooth throughout, not at all rugose near the sides. *Elytra* two-fifths longer than wide, but slightly wider than the prothorax, parallel and straight at the sides, very obtusely rounded at apex, sparsely and somewhat coarsely punctate. *Abdomen* closely and rather coarsely cinereo-pubescent. Length 2.25–2.8 mm.; width 0.9–1.2 mm.

New Mexico.

The male from which the description is drawn is much smaller than the female, and has the fifth ventral evenly truncate at apex but otherwise devoid of modification. In the female the head is only slightly smaller when compared with the prothorax, but the latter is decidedly smaller with regard to the elytra, and the dark elytral stripes are much more evident in the single specimen representing the latter sex. Two specimens.

42. **T. prominens** n. sp.—Oblong, parallel, rather stout, strongly convex, black, without metallic lustre, polished; legs red throughout; antennæ blackish, joints three to five more or less rufous; pubescence cinereous, rather long, decumbent and sparse anteriorly, dense, shorter, coarser and intermingled with erect cinereous setæ uneven in distribution on the elytra; marginal cilia moderately long, pale and fimbriiform. *Head* not much more than one-half as wide as the prothorax, convex, very finely, sparsely punctate, the interspaces smooth throughout; impressions large and very feeble; epistoma short and broad, trapezoidal; labrum very small, strongly rounded; mandibles somewhat well developed; eyes large but not prominent; antennæ small and slender, gradually and feebly incrassate, not as long as the prothorax, the tenth joint moderately transverse, fifth not dilated. *Prothorax* three-fourths wider than long, the sides distinctly convergent, evenly and extremely feebly arcuate from base to apex, the latter much narrower than the base, rectilinearly truncate but abruptly and anteriorly oblique at the sides, the apical angles anteriorly prominent, acute and but slightly blunt; basal angles slightly acute, very feebly everted and but slightly blunt; base feebly arcuato-trun-

cate; disk minutely and remotely punctate, the interspaces smooth and polished throughout, not at all rugose at the sides, the surface broadly reflexed toward the basal angles. *Elytra* one-half longer than wide, only slightly wider than the prothorax, parallel and straight at the sides, very broadly and obtusely rounded at apex; punctures fine and rather close-set, the interspaces relatively wide and polished. *Abdomen* densely punctulate and densely and somewhat coarsely cinereo-pubescent, the legs moderate in length and rather slender. Length 3.8 mm.; width 1.45 mm.

California (southern).

The type is a female, having the fifth ventral broadly subangulate at tip, the edge however almost concealed by the dense and porrect cinereous pubescence.

43. **T. cuspidatus** n. sp.—Oblong, strongly convex, moderately shining, black, the legs red throughout; antennæ dusky, the third, fourth and fifth joints more or less testaceous; pubescence cinereous, short and very dense throughout, intermingled on the elytra with erect cinereous setæ which are moderate in length, uneven and rather close-set; marginal cilia short, dense on the prothorax, much longer on the elytra, fimbriiform and ashy. *Head* three-fourths as wide as the prothorax, finely, sparsely punctate, the impressions large and distinct; epistoma narrow and unusually long; labrum cordiform, but slightly wider than long, narrowly parabolic at apex; eyes large, extending to the base but only moderately prominent; antennæ stout, bristling with short dense and erect setæ, about as long as the prothorax, the outer seven joints wider and distinctly asymmetric, penultimate joints transverse. *Prothorax* long, about one-third wider than long, the sides just visibly convergent-evenly and feebly but distinctly arcuate from base to apex, the latter truncate-only slightly narrower than the base, the apical angles anteriorly and feebly prominent and small, the basal broadly rounded and obsolete; disk minutely, not densely punctate, the interspaces polished, not rugose laterally. *Elytra* two-fifths longer than wide, only slightly wider than the prothorax, parallel and straight at the sides, very broadly and obtusely rounded at apex, the punctures fine and close-set. *Legs* and abdomen cinereo-pubescent. Length 3.3 mm.; width 1.4 mm.

California (southern).

This species is founded upon a single male, apparently from the same source as the preceding female, but the differences are so radical in the structure of the epistoma and basal angles of the prothorax that it seems impossible to consider the two forms as a single species. In this male the fifth ventral is very short, and is broadly sinuato-truncate at apex.

44. **T. indutus** n. sp.—Elongate-oval, strongly convex, black, the legs red with the tarsi somewhat dusky; antennæ black, joints two to four more

or less testaceous; pubescence pale yellowish, moderate in length, rather coarse, dense throughout, the longer pale hairs of the elytra scarcely evident, being much inclined; marginal cilia very short, dense, recurved and fimbriiform on the prothorax, very much longer and sparser on the elytra. *Head* barely three-fifths as wide as the prothorax, convex, minutely, sparsely punctate, smooth and polished throughout, the frontal impressions very feeble; epistoma elongate, less than one-half wider than long, pale; labrum about as long as wide, acutely parabolic at apex; eyes large but not prominent; antennae as long as the prothorax, feebly incrassate, the penultimate joints moderately transverse, fifth scarcely dilated. *Prothorax* two-thirds wider than long, the sides feebly convergent from base to apex and feebly arcuate, more distinctly though broadly so behind the middle; apex rectilinearly truncate, anteriorly oblique at the sides, the angles acute and scarcely blunt; basal angles broadly obtuse but distinct; disk minutely and sparsely punctate; interspaces smooth and polished, not in the least rugose at the sides. *Elytra* three-fourths longer than wide, scarcely visibly wider than the prothorax, parallel and straight at the sides, semi-circularly rounded at apex, finely and densely punctate, the interspaces smooth, slightly rugiform as usual by anteriorly oblique light. *Abdomen* finely, densely punctulate, densely cinereo-pubescent, the legs moderately long. Length 3.0 mm.; width 1.2 mm.

#### Arizona.

This distinct species is represented before me by a single female from an unknown part of the Territory. The longer hairs of the elytra are so much inclined and so indistinct that their presence might readily be overlooked, and the species assigned to the preceding subdivision of the genus.

45. **T. fimbriatus** n. sp.—Oblong, parallel, evenly convex, piceous-black; legs and antennae blackish throughout; vestiture moderately long, coarse, dense throughout, bright fulvous in color, the elytra with long, erect, very coarse and conspicuous setae of the same color, uniformly distributed over the entire surface; marginal cilia rather short, very dense, reclined and fimbriiform on the prothorax, much longer on the elytra, pale. *Head* three-fourths as wide as the prothorax, convex, finely but strongly, sparsely punctate; interspaces smooth and polished throughout; frontal impressions almost obsolete; epistoma extremely short and broad; labrum strongly rounded; eyes large but only moderately prominent; antennae distinctly longer than the prothorax, rather slender, feebly incrassate, the penultimate joints moderately transverse, fifth scarcely at all dilated. *Prothorax* twice as wide as long, the sides prominently rounded behind the middle, convergent and feebly arcuate thence to the obtuse and rounded apical angles, and still more convergent and straight to the basal angles, which are very obtuse and indistinct; apex truncate, with a very broad and obsolete entering angle at the middle, as wide as the base; disk finely but strongly, sparsely punctate; interspaces smooth and polished, but slightly rugose near the sides. *Elytra* fully one-half longer than wide, not at all wider than the widest part of the prothorax, parallel, semi-

circularly rounded behind, rather finely but strongly punctate with polished interspaces, which are relatively much wider than the punctures. *Abdomen* and legs polished, coarsely but not very densely cinereo-pubescent. Length 2.7 mm.; width 1.1 mm.

California.

The male type of this very isolated species has the fifth ventral short and broadly, feebly sinuato-truncate at apex, but without further modification. *Fimbriatus* may be known at a glance by the very short angulate and strongly fimbriate prothorax, very coarse and bristling pale setæ of the elytra, and by the fulvous pubescence.

46. **T. pruinosus** n. sp.—Elongate, subparallel, convex, polished, black, without metallic lustre; legs and antennæ black, the tarsi slightly rufo-piceous; vestiture cinereous, denuded and mutilated in the types but apparently unusually short, rather dense, with the erect pale setæ short and only distinct toward apex, intermingled toward the sides of the pronotum with some long stiff black hairs; marginal cilia long, stiff, black and sparse throughout. *Head* rather more than three-fourths as wide as the prothorax, convex, finely, sparsely punctate, smooth and polished throughout, the frontal impressions small and very feeble; epistoma large, arcuato-truncate, strongly transverse, pale and coriaceous; labrum large, broadly rounded, blackish in color; eyes rather large but not prominent, somewhat distant from the prothorax; antennæ about as long as the prothorax, not very stout, the outer joints moderately transverse, strongly asymmetric, with the apical sensitive patches well developed, fifth scarcely dilated, third and fourth feebly picescent. *Prothorax* long, scarcely more than one-fourth wider than long, the sides just visibly convergent and very slightly arcuate, more distinctly so near the base, the basal angles obtuse but not rounded, slightly prominent though blunt; apical slightly obtuse and narrowly rounded; apex feebly arcuato-truncate, very little narrower than the base, the latter evenly and strongly arcuate throughout; disk minutely, rather sparsely punctate, smooth, not rugose at the sides. *Elytra* nearly three-fourths longer than wide, perceptibly wider than the prothorax, evenly rounded behind, parallel, finely and rather closely punctate. *Abdomen* clothed with somewhat long coarse and cinereous pubescence. Length 3.1–4.2 mm.; width 1.15–1.5 mm.

California.

The two female types before me differ greatly in size, and have the pubescence not only denuded in great part but more or less broken, so that it is not possible to state its true development with much precision. The species is remarkably distinct, as may be judged by the description, and is one of those forms which it is difficult to assign to either *Byturosomus* or *Emmenotarsus* of Motschulsky, proving that those groups are not tenable as genera.

47. **T. fuscus** Lec.—Proc. Acad. Nat. Sci., Phila., VI, p. 169 (*Dasytes*); l. c., 1866, p. 351 (*Pristoscelis*).

Oblong, very stout, convex, shining, black; legs and antennæ rufous; pubescence cinereous, moderate in length and coarseness, dense on the elytra, sparser and finer on the pronotum; erect setæ of the elytra pale; pronotum with a few blackish setæ toward the sides anteriorly; marginal cilia very long and blackish on the prothorax, equally long but paler on the elytra. Head not quite one-half as wide as the prothorax, smooth, minutely and sparsely punctate; antennæ moderate. Prothorax fully three-fourths wider than long, the sides feebly convergent, evenly and distinctly arcuate from base to apex; all the angles obtuse and broadly rounded; base rather strongly arcuate toward the middle; disk smooth and polished throughout, minutely and sparsely punctate. Elytra two-fifths longer than wide, scarcely visibly wider than the prothorax, parallel, evenly and broadly rounded at apex, finely and somewhat closely punctate. Length 3.0–3.6 mm.; width 1.4–1.7 mm.

California (San Diego Co.). The above sketch refers to the female, and the male, as remarked by LeConte, is quite different in form, being less stout, with the head a little more than one-half as wide as the prothorax, the latter scarcely more than one-half wider than long though similar otherwise, except that the pubescence is a little darker and less obvious in the median parts of the disk, and that the elytra are relatively shorter, narrowed feebly from the base and not at all wider than the prothorax; in the female the elytra are much more than twice as long as the prothorax, while in the male they are quite as conspicuously less than twice as long. The fifth ventral in the male is broadly and feebly sinuate at apex but otherwise unmodified, and, in both sexes, the pronotum is feebly indented in the middle near the base.

48. **T. seriellus** n. sp.—Oblong-oval, rather stout and convex, black; legs black with the tibiæ and tarsi rufescent; antennæ dark rufo-piceous; pubescence cinereous, moderately long and coarse, dense and intermingled with erect pale setæ on the elytra, rather less dense on the pronotum; marginal cilia of the prothorax rather short, dense and fimbriiform, of the elytra longer and less close-set, pale throughout. Head fully three-fourths as wide as the prothorax, convex, smooth and polished throughout, minutely and sparsely punctate; frontal impressions rather large and feeble; epistoma moderately

long, wide, truncate; labrum obtusely ogival at apex, bristling with long setae; eyes rather large and convex, not quite attaining the base; antennae broad and compressed, a little longer than the prothorax, the penultimate joints very strongly transverse. *Prothorax* two-thirds wider than long, the sides subparallel, evenly and moderately arcuate from base to apex, the latter broadly arcuate with a very obsolete entering angle at the middle, the apical angles obtuse and rounded; basal angles, obtuse but not rounded and minutely, feebly prominent; base arcuate; disk minutely and sparsely punctate, smooth and polished throughout. *Elytra* scarcely one-half longer than wide and only just visibly wider than the prothorax, parallel, evenly rounded at apex, rather finely but strongly and closely punctate. Length 2.6–3.2 mm.; width 1.15–1.45 mm.

#### Utah.

The description refers to the male, in which sex the intromittent organ is in the form of a flattened cylindrical sheath, obliquely truncate at apex, with the inferior surface produced at tip in a fine slender cusp-point. In the female the head is not more than two-thirds as wide as the prothorax. Numerous specimens.

Several specimens apparently not differing otherwise, have the legs and antennae rufous throughout, the apical joint of the latter blackish.

49. **T. sobrinus** n. sp.—Oblong-suboval, moderately convex, polished throughout, the head and pronotum not at all rugose even at the sides, black; legs and antennae rufous, the eleventh joint of the latter dusky; pubescence ochreo-cinereous, moderately long and coarse, dense and intermingled with erect, pale and coarse hairs on the elytra, more decumbent and sparser anteriorly; marginal cilia pale, somewhat long, dense and fimbriiform on the prothorax, scarcely longer but more distant on the elytra. *Head* three-fifths as wide as the prothorax, convex, minutely and sparsely punctate, the frontal impressions very feeble; epistoma rather long and narrower than usual, pale and coriaceous; labrum almost as long as wide, strongly and nearly evenly rounded and pale at apex; eyes rather large, slightly prominent, not attaining the base, the tempora behind them opaque and asperate; antennae somewhat stout, distinctly longer than the prothorax, the penultimate joints strongly transverse, fifth not dilated. *Prothorax* nearly three-fourths wider than long, parallel and very feebly arcuate at the sides to basal third, there more prominently rounded and thence more convergent and nearly straight to the basal angles, which are obtuse but distinct and minutely prominent; apical angles obtuse and broadly rounded; apex and base broadly arcuate; disk minutely and sparsely punctate. *Elytra* not quite one-half longer than wide, scarcely perceptibly wider than the prothorax, parallel, evenly rounded at apex, finely and closely punctate. *Abdomen* finely cinereo-pubescent. Length 3.3 mm.; width 1.2–1.3 mm.

#### California.

The male above described has the fifth ventral short and broadly, feebly sinuato-truncate at apex. The female differs from the male in the larger and more elongate elytra, the head and prothorax being relatively smaller, but having nearly the same ratio between themselves. Two specimens from an unrecorded part of the State.

50. **T. mucidus** n. sp.—Oblong-oval, strongly convex, black, the legs and antennæ rufous, the first and eleventh joints of the latter darker; pubescence rather short, closely decumbent, pale yellowish-cinereous in color, very coarse and dense, intermingled on the elytra with a few suberect pale setæ toward the sides, coarse but a little less dense and directed obliquely backward toward the middle on the pronotum; marginal cilia somewhat short and fibriform, pale. *Head* two-thirds as wide as the prothorax, convex, smooth, finely, sparsely punctate, the impressions very feeble; epistoma rather short and transverse with a fine pale coriaceous margin; labrum strongly rounded; eyes moderately large and prominent, not attaining the base; antennæ but slightly longer than the prothorax, the outer joints moderately transverse and asymmetric, fifth not perceptibly dilated. *Prothorax* three-fifths wider than long, widest and broadly rounded at basal third, the sides thence feebly convergent and slightly arcuate to the obtuse and widely rounded apical angles, and convergent and nearly straight for a short distance to the basal angles which are obtuse but evident and minutely, feebly prominent; apex subtruncate toward the middle, much narrower than the base, the latter broadly, feebly arcuate; disk minutely and relatively not densely punctate, very feebly rugulose toward the sides. *Elytra* one-half longer than wide, scarcely at all wider than the prothorax, the sides parallel and straight; apex evenly and not very broadly rounded; disk finely and closely punctate. *Abdomen* and legs densely clothed with short luteo-cinereous pubescence. Length 2.7 mm.; width 1.2 mm.

California.

The unique male type represents a species evidently allied closely to the two preceding, but differing in the very feebly developed erect setæ of the elytra and in the convergent sides of the prothorax. The sexual characters are feeble as usual, the apex of the fifth ventral being broadly and obsoletely sinuato-truncate.

51. **T. brevicornis** Lec.—Proc. Acad. Nat. Sci., Phila., VI, p. 169 (Dasytes); l. c., 1866, p. 353 (Pristoscelis).

Oblong, strongly convex, moderately shining, black, the legs and antennæ rufous, the latter feebly obscure toward tip; pubescence pale, moderate in length and coarseness, rather dense but not concealing the surface, the inclined setæ on the elytra only

distinct toward the sides; marginal cilia rather long, pale. Head three-fifths as wide as the prothorax, strongly and rather closely punctato-rugose, the impressions subobsolete; epistoma rather long, transverse, pale, the labrum one-half wider than long, broadly arcuato-truncate; eyes moderate in size and prominence, not attaining the base; antennae a little longer than the prothorax, rather slender, joints five to seven subequal, eighth smaller, nine to eleven wider, the tenth moderately transverse. Prothorax two-thirds wider than long, the sides parallel, broadly and strongly arcuate, more convergent and straighter anteriorly, the apex truncate and equal to the base; apical angles obtuse but scarcely at all rounded from above, the basal very obtuse; disk strongly asperato-punctate, more rugose toward the sides; punctures not very coarse. Elytra three-fifths longer than wide, very slightly wider than the prothorax, parallel and straight at the sides, evenly rounded at apex, rather finely but asperately and somewhat closely punctate. Abdomen somewhat thinly cinereo-pubescent. Length 2.5 mm.; width 1.0 mm.

California (southern). The description is taken from the female, which is the only sex which I have seen, and in that sex the fifth ventral is evenly and strongly rounded behind. The species may be readily distinguished from the others which immediately precede by its more asperate sculpture and smaller size.

52. **T. vilis** n. sp.—Oblong, moderately convex, dull, the elytra shining, black, the legs pale ferruginous throughout; antennae black, gradually pale toward base, the first joint palest; pubescence rather long and coarse but only moderately dense, not at all concealing the surface, cinereous, the semi-erect pale hairs very sparse and only visible toward the sides of the elytra; marginal cilia long and pale throughout, scarcely fimbriiform. Head three-fourths as wide as the prothorax, asperately though not densely punctate, the interspaces strongly reticulato-rugose; impressions very feeble, epistoma moderate in length, partly pale; labrum small, almost semi-circularly rounded; eyes moderate, slightly prominent, not attaining the base; antennae well developed, one-third longer than the prothorax, compact, the outer joints not at all asymmetric and feebly transverse, fifth only just visibly larger. Prothorax three-fifths wider than long, the sides parallel, evenly and strongly arcuate throughout; angles all obtuse; apex and base equal and somewhat arcuato-truncate; disk rather finely and sparsely but asperately punctate, the surface densely reticulato-rugose, rather more strongly so toward the sides. Elytra not quite one-half longer than wide, scarcely visibly wider than the prothorax, parallel, very broadly and rather abruptly rounded behind, strongly but not very densely punctate, the punctures small and feebly asperate but at the same



time broadly impressed. *Abdomen* rather thinly cinereo-pubescent, the legs decidedly thick. Length 1.7-2.6 mm.; width 0.8-1.15 mm.

California (San Diego). Mr. Dunn.

The female differs from the above described male in its larger size, relatively longer and wider elytra, smaller head, more slender and less claviform anterior tibiae and especially in its much shorter and more slender antennae, with the fifth joint distinctly dilated and very transverse, the sixth and eighth being small; also in the smoother sculpture of the pronotum. The fifth ventral of the male is very short and transversely truncate.

This species, which was taken in some abundance, is evidently allied to *brevicornis*, but may be distinguished by the sparser vestiture, less transverse prothorax which is more evenly rounded at the sides, and by slight differences in the antennal structure of the female.

53. **T. insignis** n. sp.—Oblong, stout and convex, polished, black; legs and antennae black with the funicle of the latter slightly pale toward base, and the tarsi piceous; pubescence rather long, dense and decumbent, pale luteo-cinereous, becoming blackish in a discal spot on each elytron near the base and another much larger behind the middle; body bristling throughout with long erect black setae. *Head* scarcely more than one-half as wide as the prothorax, smooth, finely but strongly and sparsely punctate, the impressions very feeble; epistoma long, truncate; labrum long, strongly rounded at apex; eyes rather large, nearly attaining the base; antennae somewhat slender and scarcely at all incrassate, a little longer than the prothorax, the outer joints not asymmetric and but feebly transverse, fifth only slightly dilated. *Prothorax* three-fifths wider than long, widest slightly behind the middle where the sides are very broadly and obtusely subangulate, thence just visibly convergent and straight to the basal angles which are nearly right and but slightly blunt, more convergent and straight to the apical angles which are but slightly blunt and somewhat prominent anteriorly from above; apex distinctly narrower than the base, both transversely truncate; disk finely, sparsely punctate and highly polished, not at all rugose laterally. *Elytra* one-half longer than wide, only slightly wider than the prothorax, parallel and straight at the sides, evenly but rather broadly rounded at apex, the punctures fine but strong and rather close-set. *Abdomen* very minutely and densely punctulate, densely clothed, as are also the legs, with luteo-cinereous pubescence. Length 3.6-4.0 mm.; width 1.6-1.8 mm.

California (southeastern).

The two representatives of this striking species before me are both females, and the second specimen has the two large dark spots on each elytron subconfluent, the posterior pair uniting also transversely on the suture.

54. **T. curticollis** n. sp.—Oblong, robust, convex, black with a slight piceo-violaceous tinge, the integuments polished; legs bright rufo-ferruginous throughout; antennæ piceo-testaceous, blackish beyond the middle and at base; pubescence rather long, coarse, decumbent, moderately dense and pale luteo-cinereous, becoming blackish in a central region of the pronotum and in two large discal spots on each elytron, one near the base and the other, but slightly larger, behind the middle; erect black setæ long but rather sparse. *Head* slightly more than one-half as wide as the prothorax, smooth, finely but strongly, sparsely punctate, more closely so along the middle, the impressions feeble; epistoma moderate in length and strongly transverse; labrum rather short but large, broadly rounded at apex; eyes large, somewhat prominent; antennæ very much longer than the prothorax, slightly incrassate toward apex, the penultimate joints subtriangular, somewhat asymmetric and but slightly wider than long, fifth not dilated. *Prothorax* fully three-fourths wider than long, the sides very feebly convergent, evenly and feebly arcuate from base to apex, the apex transversely truncate throughout, slightly narrower than the base which is feebly arcuate; apical angles obtuse and distinctly though narrowly rounded, not in the least prominent anteriorly, the basal obtuse but distinct and feebly reflexed; disk finely, sparsely punctate, not at all rugose toward the sides. *Elytra* scarcely two-fifths longer than wide, distinctly wider than the prothorax, parallel and straight at the sides, broadly and evenly rounded at apex, finely and moderately closely punctate. *Abdomen* rather thinly cinereo-pubescent. Length 3.5 mm.; width 1.5 mm.

California.

The type of this species is also a female. It resembles *insignis* at first sight, because of the four quasi-denuded spots of the elytra, but may readily be distinguished by the pale legs, short prothorax with more obtuse apical angles, shorter and broader epistoma and labrum, longer antennæ and other characters. A single specimen from an unrecorded part of the State.

Another female, evidently immature, represents a species closely allied to this but without the dark elytral spots, with a less transverse prothorax and with much more numerous erect black setæ.

55. **T. suturalis** Lec.—Proc. Acad. Nat. Sci., Phila., VI, p. 169 (Dasytes); l. c., 1866, p. 354 (Pristoscelis); *conformis* Lec.: l. c., VI, p. 169 and 1866, p. 354.

Oblong-oval, rather stout, strongly convex, black and very highly polished throughout; legs and antennæ deep black; vestiture consisting of long erect and bristling black setæ which are rather close-set throughout and intermingled toward the sides and basal angles of the pronotum and flanks of the elytra with some

short cinereous hairs; suture bordered narrowly with stiff inclined cinereous hairs; scutellum sparsely clothed with short fine brown hairs. Head two-thirds as wide as the prothorax, convex, smooth, finely and sparsely punctate, the impressions small and very feeble; antennæ well developed, about as long as the prothorax, distinctly incrassate, the penultimate joints strongly transverse. Prothorax large, two-fifths wider than long, the sides just visibly convergent and extremely feebly arcuate from base to apex, feebly serrulate, becoming slightly sinuate toward base, the angles distinct; apical angles nearly right and very distinct; disk minutely, sparsely punctate throughout. Elytra at base exactly equal to the base of the prothorax and closely applied throughout the width, three-fifths longer than wide, the sides just visibly convergent from the base; apex rather strongly rounded; punctures fine but sparse and somewhat strong. Length 2.4–3.75 mm.; width 1.1–1.7 mm.

California (San Diego). An abundant species, represented in my cabinet by a large series exhibiting as usual great variability in size. The description here given is taken from the male, and the female is broader with a relatively more transverse prothorax, slightly smaller head and parallel elytra which are more broadly rounded at apex. I cannot distinguish the original types of *conformis* from this species.

56. **T. varius** n. sp.—Oblong, strongly convex, shining, black or with a faint piceous tinge; elytral apices rufescent; legs, epistoma and labrum pale rufo-testaceous; antennæ testaceous, blackish toward apex; pubescence short, dense, decumbent, pale luteo-cinereous, blackish and inconspicuous in a broad pronotal vitta, and in a broad and well defined stripe on each elytron not attaining the apex and nearer the suture than the exterior margin; erect hairs, long, cinereous, scarcely evident toward the middle but dense and bristling laterally. *Head* nearly four-fifths as wide as the prothorax, finely, sparsely punctate, smooth, the impressions sub-obsolete; epistoma transverse; labrum large, strongly rounded; eyes prominent, moderate in size; antennæ rather slender, strongly serrate and setose within, one-third longer than the prothorax, the tenth joint but little wider than long and subtriangular, fifth slightly dilated. *Prothorax* rather small, not quite one-half wider than long, the sides feebly convergent from base to apex and strongly, almost evenly arcuate; angles very obtuse and rounded; apex narrower than the base, arcuate; disk finely and sparsely punctate, polished, not at all rugose laterally. *Elytra* one-half longer than wide, at base about one-third wider than the prothorax, the sides feebly convergent from the base; apex obtuse; disk rather finely but strongly, not very densely punc-

tate. *Abdomen* thinly cinereo-pubescent. Length 2.8–3.2 mm.; width 0.95–1.35 mm.

Arizona (Benson). Mr. Dunn.

A very distinct form, represented before me by numerous specimens displaying considerable variation, the central dark area of the pronotum being wholly obliterated in some cases. The male above described differs from the female in its smaller size and narrower form, and the female has the elytra larger and parallel, the antennæ relatively shorter and the head barely three-fourths as wide as the prothorax; the fifth ventral of the male is feebly sinuato-truncate at tip. Many of the examples before me have the entire elytra rufo-ferruginous, except a clouded piceous area at the base.

57. **T. quadricollis** Lec.—Proc. Acad. Nat. Sci., Phila., 1859, p. 75 (*Dasytes*); l. c., 1866, p. 354 (*Pristoscelis*).

Oblong, rather stout and strongly convex, polished, the head and prothorax not at all rugose toward the sides, black, without metallic lustre; legs black, the tarsi and antennæ slightly piceous; pubescence consisting of numerous long erect and black hairs, confusedly intermingled on the elytra with a very few coarse and cinereous dispersed hairs, which are only slightly more numerous toward the suture, sides and apex. Head nearly two-thirds as wide as the prothorax, convex, finely, sparsely punctulate, the frontal impressions rather small and well marked; epistoma transverse; labrum strongly rounded, pale toward tip; antennæ distinctly longer than the prothorax, the outer joints transverse, clothed with fine sparse hairs which become shorter, denser and more erect setæ within. Prothorax three-fifths wider than long, the sides almost parallel and very feebly arcuate, becoming slightly sinuate and convergent near the basal angles which are obtuse but distinct and slightly reflexed; apex rectilinearly truncate, very feebly and anteriorly oblique near the sides, the apical angles only slightly obtuse and blunt; base arcuate; disk finely, sparsely punctate. Elytra nearly two-thirds longer than wide and one-fourth wider than the prothorax, parallel, dehiscent and broadly rounded behind, finely but strongly, not very densely punctate. Length 3.4 mm.; width 1.35 mm.

California (southern). The description given above refers to the female, and the species exhibits a close affinity with *sutu-*

*ralis*, differing in the nature of the vestiture, narrower form of the body, and in the smaller and narrower prothorax of the female.

58. **T. remotus** n. sp.—Elongate, suboval, convex, polished, black, without metallic lustre; legs and antennæ black throughout; pubescence coarse, sparse, subdecumbent, in great part cinereous on the pronotum, blackish with cinereous hairs confusedly interspersed on the elytra especially near the suture, apex and flanks; entire body bristling with numerous very long erect blackish setæ. *Head* rather small, two-thirds as wide as the prothorax, convex, smooth, finely but strongly and sparsely punctate, the frontal impressions very feeble; eyes moderate in size, rather prominent; antennæ somewhat slender, only very feebly incrassate, one-third longer than the prothorax, the outer joints scarcely asymmetric, the tenth moderately transverse, fifth feebly dilated. *Prothorax* two-thirds wider than long, parallel, the sides almost evenly and rather strongly arcuate, more convergent and very feebly sinuate near the basal angles which are obtuse but distinct and feebly reflexed; apical angles obtuse and rounded; apex and base equal, broadly and almost equally arcuate; disk finely but strongly, sparsely punctate, not at all rugose near the sides. *Elytra* elongate, nearly three-fourths longer than wide, very slightly wider than the prothorax and about three times as long, parallel and straight at the sides, the apex evenly and not very broadly rounded; disk finely and somewhat closely punctate. *Abdomen* densely cinereo-pubescent, the legs well developed. Length 3.5 mm.; width 1.3 mm.

#### California.

A single male from an unknown part of the State serves as the type of this species; the fifth ventral is unusually long, trapezoidal and truncate but otherwise unmodified, and the inner spur of the anterior and middle tibiæ is widely dilated. *Remotus* may be distinguished from *quadricollis* by the rounded sides of the prothorax and much smaller head.

59. **T. conspersus** n. sp.—Elongate, moderately convex, polished, black with scarcely any metallic lustre; legs piceous, the antennæ black; pubescence coarse, moderately long, subdecumbent, cinereous, sparse on the pronotum, distinct and rather dense throughout the elytra except in a narrow and indefinite region on each near the suture where it becomes partly blackish and inconspicuous; body bristling throughout the upper surface with numerous long erect black setæ, which are somewhat longer toward the sides of the pronotum than on the elytra. *Head* two-thirds as wide as the prothorax, smooth throughout, finely and sparsely punctate, the frontal impressions very feeble; epistoma rather long and unusually narrow; labrum strongly rounded; eyes somewhat large but not very prominent, not attaining the base; antennæ scarcely longer than the prothorax, the penultimate joints moderately transverse. *Prothorax* two-thirds wider than long, widest just behind the middle,

where the sides are broadly rounded, thence becoming distinctly convergent and very feebly arcuate to the apical angles, which are slightly obtuse but very distinct and scarcely at all rounded, convergent and feebly sinuate very near the basal angles, these being obtuse but distinct; apex and base equal, broadly, feebly arcuate; disk finely and sparsely punctate, not rugose laterally. *Elytra* two-thirds longer than wide, nearly one-fourth wider than the prothorax, the sides subparallel, feebly sinuate behind the unusually tumid humeri; apex evenly and not broadly rounded; disk finely but strongly, not very densely punctate. *Abdomen* densely punctulate, not very conspicuously cinereo-pubescent. Length 3.2 mm.; width 1.1 mm.

California (Sta. Barbara). Mr. Dunn.

This species may be distinguished from the preceding by its much more slender form, anteriorly convergent sides of the prothorax and shorter erect setæ of the elytra, as well as by the more abundant cinereous pubescence, which last however is a variable character. It is represented by a single female example.

60. **T. mexicanus** n. sp.—Oblong, not very stout, strongly convex, feebly shining, black; legs pale rufo-ferruginous throughout; antennæ in great part pale; pubescence rather long and coarse but sparse, whitish, subdecumbent, darker and less conspicuous in an elongate streak on each elytron near the suture; body bristling above with numerous long erect blackish setæ. *Head* nearly four-fifths as wide as the prothorax, strongly and rather closely punctured, the interspaces smooth and polished throughout; frontal impressions feeble; epistoma transverse; labrum strongly rounded, in great part pale; eyes moderate in size and rather prominent; antennæ somewhat long, distinctly serrate. *Prothorax* unusually elongate, only very slightly wider than long, subglobularly convex, the sides broadly rounded behind, sensibly convergent and nearly straight anteriorly, the apex distinctly narrower than the base, both arcuate; angles obtuse and scarcely distinct, the posterior apparently broadly rounded; disk rather coarsely, deeply and closely punctate, not rugose at the sides. *Elytra* two-thirds longer than wide, only slightly wider than the prothorax, parallel and straight behind the humeri which are somewhat prominently tumid; apex evenly, not very broadly rounded; disk coarsely, strongly and densely punctured. *Abdomen* and legs rather densely cinereo-pubescent. Length 2.75 mm.; width 1.05 mm.

Mexico (northern). Cab. Levette.

This species is wholly different from any of those with which it must be associated in this revision, especially in the elongate and more globular form of the prothorax and coarse close punctation. The description refers to the male, in which sex the fifth ventral is truncate as usual. *Mexicanus* is represented by two similar male examples which cannot apparently be associated

with any of the few species described in the "Biologia" under the name *Pristoscelis*.

61. **T. rufipennis** Lec.—Proc. Acad. Nat. Sci., Phila., 1858, p. 71 (*Dasytes*); l. c., 1866, p. 356 (*Pristoscelis*).

Stout, black, the elytra throughout pale rufous; integuments polished; pubescence in great part denuded in the type but apparently rather short, sparse and comparatively inconspicuous, erect along the sides of the body; antennæ short, incrassate, the outer joints transverse. Prothorax three-fifths wider than long, the sides parallel and broadly arcuate; apical and basal angles broadly rounded; disk evenly convex, finely and sparsely punctate. Elytra one-fourth wider than the prothorax and three times as long, more coarsely and strongly and a little more closely though still not densely punctured. Length 5.5 mm.; width 2.3 mm.

Arizona (Gila.) The only known specimen is the unique type in the cabinet of LeConte, from which the above superficial notes were taken a few years since. It may be recognized by its unusually large size and by its coloration.

62. **T. lobatus** n. sp.—Subcylindrical, convex, shining, black; legs black, the tibiæ and tarsi rufescent; antennæ black, the funicle slightly rufescent toward base; pubescence cinereous, subdecumbent, rather long and dense, intermingled with a few long blackish setæ toward the sides of the pronotum, the erect hairs of the elytra very coarse and abundant but only moderately long, inclined posteriorly and cinereous, longer at the margins. Head three-fourths as wide as the prothorax, finely, sparsely punctate, the frontal impressions feeble; epistoma moderately short, impunctate and thin toward apex; labrum short and transverse though large, very broadly rounded; eyes rather large; antennæ distinctly incrassate, a little longer than the prothorax, clothed densely with short stiff hairs, the penultimate joints transverse. Prothorax three-fifths wider than long, the sides perfectly parallel and very feebly arcuate almost throughout, feebly sinuate toward the basal angles which are obtuse but distinct, the base obliquely sinuate for a short distance near the angles, broadly and strongly arcuate in the middle; apex broadly arcuato-truncate, fully as wide as the base or slightly wider, the apical angles but slightly obtuse and blunt; disk finely, sparsely punctate, rugulose only very near the lateral edges. Elytra about three-fifths longer than wide, only very slightly wider than the prothorax, parallel, evenly rounded at apex, finely and somewhat closely punctate, the interspaces polished. Abdomen and legs only moderately densely cinereo-pubescent. Length 2.7 mm.; width 1.1 mm.

California (Sta. Barbara). Mr. Dunn.

Although to be placed near *brevipilosus* in a natural scheme of classification, this species is not closely allied; it is smaller, with the pale setæ of the elytra coarser and very much more abundant, and the lobiform base of the prothorax is more pronounced. The single male has the fifth ventral much longer than the fourth and only moderately broadly sinuato-truncate at apex.

63. **T. brevipilosus** Lec.—Proc. Acad. Nat. Sci., Phila., 1866, p. 353 (Pristoscelis).

Elongate, parallel, strongly convex, polished, black with a grayish-aneous lustre; legs piceous-black, the tibiæ and tarsi rufescent; antennæ piceous-black; pubescence rather long and moderately coarse, subdecumbent, pale fulvo-cinereous and somewhat dense, with numerous erect setæ which are long bristling and in great part black anteriorly but short and mostly pale on the elytra, where they are intermixed with a few very long black hairs toward the sides; marginal fringe of the elytra moderately long, fine and in great part ashy. Head fully two-thirds as wide as the prothorax, smooth, finely and sparsely punctate, the epistoma extremely short; labrum short and broadly rounded; antennæ scarcely longer than the prothorax, not very stout, the penultimate joints but slightly asymmetric and moderately transverse, fifth just visibly dilated. Prothorax two-thirds wider than long, the sides parallel, almost evenly and moderately arcuate; angles somewhat distinct though blunt; disk minutely, sparsely punctate, not rugose laterally. Elytra three-fifths longer than wide, only slightly wider than the prothorax, parallel, rather acutely rounded behind; humeri only moderately prominent; punctures fine but strong and relatively not very close-set. Abdomen and legs densely clothed with short coarse fulvo-cinereous pubescence. Length 3.3 mm.; width 1.3 mm.

Middle California. The female here described is the only representative which I have seen. This species is not liable to be confounded with any other known to me.

Another female, from a different locality in California, seems to represent a very closely allied species with a shorter and smaller prothorax and a less abbreviated epistoma, the latter having a much broader impunctate margin.

64. **T. hystrix** n. sp.—Oblong, strongly convex, highly polished, black with a feeble bluish-aneous lustre; legs piceous-black, the tarsi paler; an-



tennae blackish, the funicle paler toward base; pubescence rather long and coarse, not very dense, subdecumbent, intermingled throughout above with very numerous long erect black setae. *Head* two-thirds as wide as the prothorax, convex, smooth, finely and sparsely punctate, the frontal impressions very feeble; epistoma moderate in length, transverse; labrum well developed, angulate at apex; eyes rather large and prominent; antennae two-fifths longer than the prothorax, slightly incrassate toward tip, the tenth joint subtriangular, moderately transverse and but slightly asymmetric, fifth large and long though only slightly wider. *Prothorax* three-fifths wider than long, the sides parallel, evenly and rather strongly arcuate throughout, a little more convergent near the basal angles which are obtuse but not rounded and very narrowly reflexed; apical angles obtuse and rounded; apex broadly and feebly arcuate; disk finely, sparsely punctate, not rugose laterally. *Elytra* scarcely three-fifths longer than wide, only very slightly wider than the prothorax, parallel and straight at the sides, the apex moderately obtuse; punctures distinct though not coarse, rather well separated. *Abdomen* moderately densely clothed with short, fine and cinereous pubescence. Length 2.85 mm.; width 1.1 mm.

California (San Luis Obispo Co.).

Readily identifiable by the hispid black hairs, small size, strongly arcuate sides of the prothorax and other characters as detailed in the table. It is represented by a single female specimen in an excellent state of preservation.

65. **T. barbarae** n. sp.—Elongate, parallel, rather feebly convex, polished, black with scarcely a trace of metallic lustre; legs black, the tarsi picescent; antennae black, the funicle testaceous toward the base, the first joint black; pubescence rather coarse and somewhat short, moderately dense, fulvo-cinereous, intermixed throughout with long erect and bristling black setae. *Head* three-fourths as wide as the prothorax, smooth and polished, finely, sparsely punctate, the impressions feeble; epistoma transverse, moderate in length; labrum strongly rounded; eyes large; antennae slightly longer than the prothorax, feebly incrassate toward tip, the penultimate joints transverse, fifth only feebly dilated. *Prothorax* three-fifths wider than long, the sides parallel, almost evenly and very feebly arcuate throughout, convergent and slightly sinuate very near the basal angles which are obtuse but not rounded and feebly reflexed; apical angles slightly obtuse and distinctly blunt; apex nearly similar to the base, broadly and feebly arcuate; disk finely, sparsely punctate, not rugose laterally. *Elytra* two-thirds longer than wide, very slightly wider than the prothorax, parallel and straight at the sides, the apex evenly rounded; disk rather finely but strongly, quite densely punctate. *Legs* and *abdomen* densely clothed with short luteo-cinereous pubescence. Length 3.25 mm.; width 1.25–1.3 mm.

California (Sta. Barbara). Mr. Dunn.

The female differs but slightly from the male described above,

the elytra being only just visibly shorter and broader, and the head about three-fifths as wide as the prothorax. The fifth ventral in the male is transversely truncate and short as usual. Six specimens.

This species may be readily distinguished from *hystrix* by its more elongate and depressed form and feebly rounded sides of the prothorax.

66. **T. tectus** n. sp.—Oblong, rather stout, strongly convex, polished, black, without metallic lustre; legs piceous-black; antennæ black, piceous toward base; pubescence long, coarse, cinereous, subdecumbent, intermixed throughout the upper surface with moderately abundant very coarse and erect black setæ. *Head* three-fifths as wide as the prothorax, smooth and polished, rather finely but strongly and somewhat closely perforato-punctate, the impressions almost obsolete; epistoma large, transverse; labrum large and long, broadly rounded, with a transverse series of stiff setæ behind the middle; eyes rather large but not prominent; antennæ barely as long as the prothorax, feebly incrassate toward tip, the penultimate joints distinctly transverse. *Prothorax* three-fifths wider than long, parallel, the sides evenly and feebly arcuate throughout; all the angles slightly obtuse and blunt though distinguishable; apex and base equal, feebly and equally arcuate; disk finely but strongly, rather sparsely perforato-punctate, not at all rugose toward the sides. *Elytra* one-half longer than wide, not evidently wider than the prothorax, parallel and straight at the sides, the apex evenly and almost semi-circularly rounded; disk finely but strongly, closely punctate, the interspaces smooth. *Abdomen* very densely clothed with cinereous pubescence, which is rather long and coarse. Length 4.0 mm.; width 1.65 mm.

California.

The single specimen is a female without further record of locality. The species is very distinct because of its rather large size and very long shaggy coat of pale cinereous hairs, in addition to the erect setæ.

67. **T. sordidus** Lec.—Proc. Acad. Nat. Sci., Phila., VI, p. 169 (Dasytes); l. c., 1866, p. 354 (Pristoscelis).

Oblong-oval, moderately convex, polished and smooth throughout the upper surface, black, the legs and antennæ black, the funicle of the latter slightly picescent toward base; pubescence long, coarse, cinereous and rather dense, subdecumbent, intermixed throughout above with bristling erect setæ which are mostly black in color. Head scarcely three-fifths as wide as the prothorax, finely but strongly, sparsely punctate, the frontal impressions narrow, distinct and more densely punctate; epi-

stoma long, coriaceous; labrum long; eyes moderate; antennæ about as long as the prothorax, distinctly incrassate toward tip, the tenth joint transverse and scarcely at all asymmetric, the fifth but feebly dilated. Prothorax two-thirds wider than long, the sides almost evenly and rather strongly arcuate, distinctly more convergent toward apex, the latter much narrower than the base and truncate with the angles obtuse; basal angles obtuse but scarcely at all rounded and feebly reflexed as in other allied species; disk finely but strongly, sparsely punctate. Elytra three-fifths longer than wide, one-fourth wider than the prothorax and fully three times as long, parallel, semi-circularly rounded at apex, finely and rather closely punctate. *Legs* and abdomen coarsely cinereo-pubescent. Length 3.1 mm.; width 1.35 mm.

California (San Diego). The short prothorax, evidently narrowed near the apex and comparatively long and wide elytra, oval form of the body, long epistoma and other characters as noted in the description of the female given above, will serve to distinguish this species from its allies.

68. **T. villosus** n. sp.—Subcylindrical, strongly convex, polished, the surface smooth throughout above, black, the legs black with the tarsi paler; antennæ black with the funicle pale testaceous toward base; pubescence long, coarse, luteo-cinereous, dense and rather closely decumbent, intermingled with very long, abundant and bristling setæ which are black anteriorly and toward the middle of the elytra, but cinereous toward the sides and along the margins of the latter. *Head* scarcely more than three-fifths as wide as the prothorax, finely, remotely punctate, more closely so anteriorly, the frontal impressions distinct and confluent at apex just beyond a smooth subtuberculi-form elevation; epistoma rather short and broad, pale flavate; labrum strongly rounded, setose, pale and fringed with short pale setæ at apex; eyes moderately large and convex; antennæ one-third longer than the prothorax, distinctly incrassate, the funicle slender toward base, outer joints transverse, fifth much longer and slightly wider than the sixth. *Prothorax* scarcely more than one-half wider than long; the sides feebly arcuate at basal two-fifths, thence moderately convergent and straight or very feebly sinuate to the apical angles which are only slightly obtuse and scarcely at all rounded, subparallel near the base, the basal angles obtuse and distinctly rounded, obliterated but feebly reflexed; apex rectilinearly truncate, narrower than the base which is broadly arcuate; disk finely, sparsely punctate. *Elytra* scarcely three-fifths longer than wide, a little wider than the prothorax and but slightly more than twice as long, the sides straight and apparently somewhat convergent from base to apex, the latter evenly rounded; punctures rather small but strong and close-set. *Legs* and abdomen rather densely cinereo-pubescent. Length 2.8 mm.; width 1.25 mm.

## California.

The male serving as the type has the fifth ventral short and truncate, the truncature apparently feebly sinuate toward the middle.

69. **T. irrasus** n. sp.—Elongate, subcylindrical, convex, polished and smooth throughout, black, legs black, the tarsi scarcely picescent; antennæ black, the funicle dark piceo-testaceous toward base; pubescence rather long and coarse, dense, subdecumbent, pale luteo-cinereous, the upper surface bristling with long erect and very conspicuous, though not dense, black setæ which are intermingled with some shorter and more inclined pale hairs toward the sides of the elytra, the marginal hairs of the latter very long and cinereous. *Head* but slightly more than one-half as wide as the prothorax, convex, finely and sparsely punctate, a little more closely so toward apex, where the impressions are feeble and separated by the usual feeble impunctate convexity; epistoma rather long but strongly transverse, very pale and coriaceous; labrum long, black, paler and strongly rounded at apex; eyes large but not very convex, not quite attaining the base; antennæ slightly longer than the prothorax, the penultimate joints moderately transverse. *Prothorax* three-fourths wider than long, the sides convergent and very feebly arcuate from base to apex, the basal angles obtuse and rather broadly rounded, feebly reflexed; apical less obtuse and only narrowly rounded, distinct; apex and base evenly, equally and feebly arcuate throughout the width, the former distinctly the narrower; disk finely, sparsely punctate. *Elytra* three-fifths longer than wide, only just visibly wider than the prothorax, parallel and straight at the sides, broadly rounded at apex, finely but strongly and rather densely punctate. *Legs* and abdomen densely and somewhat coarsely cinereo-pubescent. Length 4.0 mm.; width 1.6 mm.

## California

The unique representative of this species, which may be readily known by the form of the prothorax, is a female, with the fifth ventral evenly rounded behind.

70. **T. crinifer** n. sp.—Oblong, parallel, moderately convex, black with a feeble grayish-æneous lustre; legs rufo-ferruginous, the posterior femora slightly obscure; antennæ piceo-testaceous; pubescence rather long, coarse and dense, subdecumbent, pale luteo-cinereous, the upper surface in addition with long but rather sparse erect black setæ. *Head* fully three-fifths as wide as the prothorax, smooth, finely and sparsely punctate, the impressions large and feeble; epistoma rather short, truncate, thin, impunctate and slightly pale toward apex; labrum short and broad, broadly rounded; eyes moderately large and slightly prominent, attaining the base; antennæ somewhat long, strongly serrate, the outer joints only moderately transverse. *Prothorax* two-thirds wider than long, the sides parallel, evenly and feebly arcuate; basal angles obtuse and blunt but somewhat distinct; apical angles less obtuse and but slightly blunt; apex and base evenly and feebly arcuate, the latter slightly the wider; disk finely and sparsely punctate. *Elytra* three-fifths longer

than wide, not perceptibly wider than the prothorax, the sides straight and subparallel; apex rather broadly rounded; disk finely and relatively not very densely punctate. *Abdomen* densely cinereo-pubescent, the legs moderate. Length 3.0 mm.; width 1.2 mm.

California.

The male described as the type has the fifth ventral feebly sinuato-truncate at apex; it is the only specimen known to me. The species is allied to *hirtellus*, but may be easily distinguished by certain peculiarities of vestiture and coloration, the tip of the elytra not being rufescent and the erect setæ blacker and sparser.

**71. *T. hirtellus*** Lec.—Proc. Acad. Nat. Sci., Phila., 1866, p. 353 (Pristoscelis).

Oblong, convex, polished, black, with a feeble grayish-metallic lustre; elytral apices pale; coriaceous hind margins of the abdominal segments and tip of the fifth pale; legs and antennæ pale rufo-ferruginous throughout; pubescence rather long, coarse and dense, pale luteo-cinereous, with long erect and sparser hairs bristling from the upper surface, these largely black anteriorly but cinereous at the edges, pale on the elytra sparsely intermingled with blackish on the disk. Head three-fourths as wide as the prothorax, strongly and rather densely punctate; epistoma moderately long, pale and polished; labrum completely pale, strongly rounded; eyes moderate, not attaining the base; antennæ long, and slender, serrate, much longer than the prothorax, the penultimate joints fully as long as wide. Prothorax rather small and transverse, one-half wider than long, the sides arcuate, convergent anteriorly, the angles all obtuse and rounded; apex and base broadly and feebly arcuate, the former distinctly the narrower; disk rather finely, not densely punctate, not rugose at the sides. Elytra oblong, one-half longer than wide, one-third wider than the prothorax, parallel, broadly rounded and almost truncate at apex, finely, strongly and somewhat densely punctured. Length 2.5–3.2 mm.; width 1.1–1.3 mm.

Lower California (Cape San Lucas). The specimen described is a female, having the fifth ventral rounded behind, though broadly so, and the tibial spurs simple. I have two males from Arizona which are apparently assignable to this species, and in these the head and prothorax are almost the same in relative size and shape, but the prothorax is larger and wider when compared with the elytra. The slender antennæ, elytral color-

tion and pale labrum will enable the reader to identify this distinct species at a glance. There is a mistake of 1 mm. in the length given by LeConte.

72. **T. fulvescens** n. sp.—Subcylindrical, moderately convex, polished, black, the elytra, metasternum and abdominal vertex more or less rufopiceous; legs pale piceo-testaceous, the tibiae and tarsi darker; antennae black; pubescence rather long and dense, very coarse, decumbent and bright fulvous, intermixed with numerous long and bristling setae, which are blackish in color but becoming in great part pale toward the sides of the elytra. *Head* nearly three-fourths as wide as the prothorax, convex, smooth, finely and sparsely punctate, the eyes large but not very convex; antennae a little longer than the prothorax, rapidly and strongly incrassate toward apex and clothed densely with short erect and cinereous setae, the penultimate joints strongly transverse. *Prothorax* two-thirds wider than long; the sides moderately convergent and almost evenly and distinctly arcuate from base to apex; basal angles obtuse and somewhat broadly rounded, feebly reflexed, the apical greatly deflexed but almost right and scarcely at all blunt; apex and base almost rectilinearly truncate, the former decidedly the narrower; disk finely, sparsely punctate, not at all rugose at the sides. *Elytra* barely three-fifths longer than wide, not noticeably wider than the prothorax, subparallel and straight at the sides, the apex evenly rounded; disk rather finely but strongly and closely punctate. *Legs* and abdomen moderately densely cinereo-pubescent. Length 3.0 mm.; width 1.15 mm.

California (San Diego). Mr. Dunn.

A well marked species, distinguishable at once by the coarse and dense fulvous vestiture, incrassate antennae, coloration and other characters; the single male before me has the fifth ventral broadly sinuato-truncate at apex.

73. **T. comatus** Lec.—Trans. Kansas Acad. Sci., 1881, X, p. 77 (Pristoscelis).

Slender, cylindrical, the pubescence coarse, whitish, sparse, with intermixed sparse and erect hairs which are very long and conspicuous. *Prothorax* transverse and almost evenly elliptical, strongly convex, almost one-half wider than long, very coarsely deeply and remotely punctate, the interspaces polished; disk bi-impressed at each side on the declivity behind the middle, the two impressions subconfluent. *Elytra* scarcely at all wider than the prothorax and more than three times as long, twice as long as wide, coarsely and more closely but not densely punctate. *Antennae* as long as the prothorax. Length 4.0 mm.; width 1.4 mm.

New Mexico (Sta. Fé Cañon—7,000 feet)—Cab. LeConte. The above observations were taken from the unique type. This species is remarkably distinct in pronotal sculpture, but the impressions alluded to may possibly be of an accidental nature, although they appear to be symmetrical.

74. **T. squalidus** Lec.—Proc. Acad. Nat. Sci., Phila., VI, p. 169 (Dasytes); l. c., 1866, p. 354 (Pristoscelis); *tejonicus* Lec.: l. c., p. 354 (Pristoscelis).

Subcylindrical, rather narrow and convex, polished, intense black, without metallic lustre; legs and antennæ more or less blackish; pubescence moderately long, cinereous, sparse especially on the pronotum but clothing the entire surface, intermixed with moderately numerous long erect and black setæ. Head two-thirds as wide as the prothorax, finely, sparsely punctate, the impressions small and feeble; epistoma rather narrow and moderately long, slightly pale; labrum strongly rounded, piceous, paler at apex; eyes moderate, rather prominent; antennæ nearly one-third longer than the prothorax, feebly incrassate, the penultimate joints distinctly transverse, fifth but feebly dilated. Prothorax three-fifths wider than long, the sides parallel and broadly, somewhat strongly arcuate; basal angles obtuse but distinct; apical obtuse; apex and base broadly arcuate, the latter rather the more strongly; disk finely, sparsely punctate, not rugose near the sides. Elytra three-fifths longer than wide, scarcely visibly wider than the prothorax, subparallel, evenly and not very broadly rounded at apex; disk finely but strongly, sparsely punctate. Length 2.7 mm.; width 1.0 mm.

California (San Diego and northward). The male has the fifth ventral longer than the fourth and less broadly truncate at apex than is usual in this section. I am completely unable to distinguish *tejonicus* from *squalidus*, the legs being somewhat variable in color, and all the other features being perfectly similar as far as can be discovered from a careful study of the types of each. The above description is drawn from a male taken near San Diego.

75. **T. sexualis** n. sp.—Elongate, moderately convex, polished, deep black, without metallic reflection; legs and antennæ black; pubescence rather short, coarse, subdecumbent, luteo-cinereous, sparsely and evenly distributed on the elytra and intermingled throughout above with erect black setæ which

are moderate in length and abundance. *Head* four-fifths as wide as the prothorax, finely and sparsely punctate, feebly rugose, especially toward the sides of the front, the impressions feeble; epistoma moderate in length, smooth, truncate and somewhat pale; labrum rather large and broadly rounded; eyes large and unusually prominent; antennæ long and not very stout, one-half longer than the prothorax, the last three joints slightly larger, tenth almost as long as wide, fifth distinctly dilated, oblique at apex. *Prothorax* one-half wider than long, the sides strongly but broadly arcuate toward base, gradually convergent and feebly arcuate toward apex, the latter truncate and subequal to the base which is arcuate; basal angles very obtuse but not wholly obliterated, the apical obtuse and blunt; disk rather finely and sparsely punctate, coarsely reto-rugose near the sides. *Elytra* three-fifths longer than wide, only slightly wider than the prothorax, parallel and straight at the sides, evenly and not very obtusely rounded behind, the disk somewhat coarsely, strongly and sparsely punctate, the punctures impressed. *Abdomen* rather finely and sparsely clothed with plumbeo-cinereous pubescence. Length 2.7-3.0 mm.; width 1.05-1.2 mm.

California (Sonoma Co.).

This species is the most remarkable of the genus in the development of the male sexual characters at the abdominal vertex. The male is described above, and the female differs in having the head and prothorax slightly smaller when compared with the elytra, although not differing much in their own individual size or form; the elytra however are distinctly broader and relatively shorter.

In the male the fifth ventral is deeply emarginate at the apex, with the bottom of the emargination rectilinearly transverse, but the concave outline of the notch is continued on the disk past this bottom truncature, forming a rounded depressed sinus with the truncature as its anterior margin and its depressed floor horizontal and flat; the disk is broadly impressed, the impression polished and impunctate toward the margins of the emargination but elsewhere bristling with short erect black and spiculiform setæ. The inner spur of all the tibiæ is strongly dilated.

76. **T. sonomæ** n. sp.—Parallel, strongly convex, highly polished, black, with a feeble greenish-metallic lustre; legs and antennæ black; pubescence rather short and fine, cinereous and sparse, interspersed with sparse black setæ which are shorter, more inclined and less conspicuous in the median parts of the elytra. *Head* nearly three-fourths as wide as the prothorax, smooth and polished, only slightly rugulose toward the sides of the front, finely and sparsely punctate, the frontal impressions large and rather feeble; epistoma well developed, smooth and impunctate; labrum transverse, large, broadly rounded; eyes large, only moderately convex; antennæ slightly longer than the pro-



thorax, feebly but distinctly incrassate toward apex, the penultimate joints rather strongly transverse. *Prothorax* nearly three-fourths wider than long, the sides somewhat strongly rounded and subprominent at basal two-fifths, thence feebly convergent and slightly arcuate to the apex and more strongly convergent and very broadly rounded into the base, which is a little narrower than the apex and subtruncate; apex rectilinearly truncate, with the angles obtuse and blunt; basal angles obliterated; disk finely, sparsely punctate, coarsely reto-rugose toward the sides. *Elytra* long, fully three-fourths longer than wide, slightly wider than the prothorax, parallel, evenly and not broadly rounded at apex, the disk somewhat coarsely, deeply and sparsely punctate, feebly explanate near the external apices, the interspaces polished. *Abdomen* and legs finely subcinereo-pubescent. Length 3.2 mm.; width 1.25 mm.

California (Sonoma Co.).

The single female before me has the fifth ventral very broadly rounded behind, and represents a species somewhat allied to *sexualis*, but with very much more elongate elytra and more obtusely rounded abdominal apex.

77. **T. texanus** Lec.—Proc. Acad. Nat. Sci., Phila., 1866, p. 355 (*Pristoscelis*).

Elongate-oval, strongly convex, polished, black, the elytra picescent; apices of the abdominal segments pale and coriaceous; legs pale rufo-ferruginous throughout; antennæ pale piceo-testaceous, the funicle still paler toward base; pubescence rather long and fine, cinereous-white and very sparse, intermingled with numerous black setæ. Head nearly three-fourths as wide as the prothorax, finely but strongly, not very sparsely perforato-punctate, the impressions large and distinct; epistoma with a wide and pale coriaceous margin; labrum large, transverse, broadly rounded, black with a narrow pale apex; eyes somewhat prominent; antennæ slender, much longer than the prothorax, serrate, the tenth joint nearly as long as wide, fifth but feebly dilated. Prothorax rather long, about two-fifths wider than long, the sides broadly arcuate, becoming gradually convergent anteriorly; basal angles very broadly rounded; apex truncate, about as wide as the base; disk rather evenly and deeply perforato-punctate, the punctures sparse but closer laterally, the interspaces smooth throughout. Elytra long, two-thirds longer than wide, distinctly wider than the prothorax and nearly three times as long, evenly and not obtusely rounded behind, the disk very coarsely, deeply and not very closely punctate. Length 2.3–3.3 mm.; width 0.95–1.25 mm.

Texas. The above description is from the female, but the male does not greatly differ, simply having the head nearly four-fifths as wide as the prothorax. The fifth ventral of the male is broadly sinuato-truncate at apex, the genital segment broadly emarginate, with its surface broadly impresso-canaliculate, and the horizontal under part of the dorsal pygidium is concave, with its anterior margin in the form of a straight transverse ridge. This species may be readily known by its coarse punctuation and rather elongate prothorax.

78. **T. lucidus** n. sp.—Elongate and rather narrow, convex, highly polished, black with a feeble subæneous lustre; legs pale rufo-ferruginous throughout; antennæ testaceous, the first joint darker and the outer joints blackish; pubescence somewhat short, cinereous and very sparse, intermixed with erect black setæ which are conspicuous anteriorly but on the elytra short, very sparse, inclined and inconspicuous on the disk though more distinct laterally, with the marginal cilia in great part cinereous. *Head* rather small, two-thirds as wide as the prothorax, distinctly rugose toward the sides, sparsely punctate in the middle, the impressions very feeble; epistoma rather long and only moderately transverse; labrum but slightly wider than long, dark, strongly rounded; eyes moderate in size but quite prominent and distant from the base, the neck feebly constricted; antennæ slender, distinctly longer than the prothorax, the last three joints abruptly wider, the penultimate transverse, fifth feebly dilated. *Prothorax* two-thirds wider than long, widest at basal two-fifths, where the sides are obtusely but somewhat prominently rounded, feebly convergent and almost straight thence to the apex, more convergent and straight to the basal angles, which are very obtuse but scarcely rounded and distinct; apical angles obtuse and rounded; apex and base subequal, arcuato-truncate; disk finely, sparsely punctate, feebly rugose very narrowly along the lateral edges. *Elytra* three-fifths longer than wide, only just visibly wider than the prothorax, parallel, the apex evenly and not very broadly rounded; disk very coarsely, deeply and not closely punctate, the interspaces highly polished and smooth. *Abdomen* thinly cinereo-pubescent. Length 2.7–3.3 mm.; width 0.85–1.2 mm.

Lower California; Guadalupe Island.

The male described above has the fifth ventral broadly arcuato-truncate at apex, the genital segment emarginate as usual throughout the width, with the surface broadly impresso-canaliculate, and the lower surface of the pygidium nearly flat. The female, of which I have but a single specimen from Guadalupe, is much larger than the male and with shorter antennæ, but otherwise scarcely differs at all.

79. **T. reversus** n. sp.—Elongate, moderately convex, polished, black with a slight grayish lustre; femora pale rufo-ferruginous, the tips blackish

above; tibiae and tarsi slightly infusate; antennae black, joints three to five more or less dark rufo-piceous; pubescence rather short and sparse, ashy-white, the intermixed setae rather abundant but unusually short and in great part pale on the elytra, especially toward the sides. *Head* not quite two-thirds as wide as the prothorax, smooth, not rugose at the sides, finely, remotely punctate, the epistoma rather long, moderately transverse; labrum almost semi-circularly rounded; eyes moderate in size but prominent, distant from the base; antennae but slightly longer than the prothorax, the last three joints just visibly wider, the penultimate transverse, fifth scarcely dilated. *Prothorax* fully two-thirds wider than long, the sides broadly rounded behind the middle, feebly convergent and straighter anteriorly, slightly convergent and sinuate toward the basal angles which are acute and minutely prominent; base strongly arcuate but becoming oblique and subsinuate near the angles; apical angles obtuse and blunt but rather pronounced; apex broadly arcuato-truncate; disk minutely and remotely punctate, feebly rugose near the basal angles only. *Elytra* scarcely three-fifths longer than wide, almost one-fourth wider than the prothorax, parallel, very feebly inflated behind, the sides slightly arcuate except near the base; apex almost evenly rounded; disk rather finely but strongly, somewhat closely punctate. *Abdomen* finely and not very densely cinereo-pubescent. Length 3.1 mm.; width 1.25 mm.

Arizona (near the Grand Cañon of the Colorado).

The single type of this distinct species is a female, with the fifth ventral rounded behind and feebly impressed on the disk in a large rounded median area; it was collected and kindly given to me by Dr. T. Mitchell Prudden, of New York.

80. **T. pedalis** Lec.—Proc. Acad. Nat. Sci., Phila., 1866, p. 355 (Pristoscelis).

Elongate-oval, strongly convex, highly polished, black with a very feeble greenish-æneous lustre; legs red; antennae dark testaceous, the first and outer joints blackish; pubescence coarse, sparse, erect and bristling, blackish throughout, the marginal fringe of the elytra more or less pale. Head scarcely more than three-fifths as wide as the prothorax, smooth, finely and remotely punctate, the impressions separated by a large and pronounced impunctate convexity; labrum strongly rounded; eyes rather large and prominent; antennae barely as long as the prothorax, slightly incrassate, the penultimate joints transverse. Prothorax large, slightly more than one-half wider than long, the sides rounded at basal third, thence distinctly convergent and very feebly arcuate to the apex, convergent and straight to the basal angles which are very obtuse but not rounded; apex truncate, de-

cidedly narrower than the base, the latter broadly arcuate; apical angles obtuse; disk finely and remotely punctate, not rugose laterally except at the immediate edges. Elytra two-thirds longer than wide, scarcely at all wider than the prothorax, parallel, rather acutely rounded behind; disk subexplanate externally at apex, with the apical edges finely serrate; punctures coarse, deep and sparse. Abdomen thinly but rather coarsely pubescent. Length 3.1–3.25 mm.; width 1.2–1.3 mm.

California (Sta. Catalina Island). I have only seen the female of this species, which may be readily recognized by the dark and erect vestiture, pale legs, polished surface and coarse elytral punctures. The prothorax is much larger and less transverse than in *lucidus* or *ænescens*.

81. **T. nigrinus** n. sp.—Elongate, subparallel, strongly convex and polished, black with a scarcely perceptible æneous lustre; legs piceous-black, the tarsi paler; antennæ pale piceo-testaceous, scarcely darker toward tip; pubescence blackish, sparse, coarse and suberect, slightly cinereous on the elytral flanks toward base, long and bristling especially anteriorly and along the margins. Head three-fourths as wide as the prothorax, smooth throughout, convex, finely and sparsely punctate, the frontal impressions rather narrow, widely separated and distinct; epistoma short; labrum acutely parabolic, gradually pale toward apex; eyes large but only moderately prominent; antennæ much longer than the prothorax, gradually and perceptibly incrassate toward tip, the penultimate joints strongly transverse, fifth distinctly dilated. Prothorax but slightly more than one-half wider than long, the sides perfectly parallel and broadly arcuate at the middle, where the disk is widest, straight toward the basal angles which are obtuse and not rounded and distinct; apical angles feebly obtuse and distinct, only slightly blunt; disk finely, sparsely punctate, not rugose near the sides. Elytra three-fifths longer than wide, distinctly wider than the prothorax, subparallel and straight at the sides, evenly rounded at apex; humeri tumid, the intra-humeral impression strong; punctures fine but strong and rather sparse. Abdomen somewhat thinly cinereo-pubescent. Length 2.75 mm.; width 1.2 mm.

California?

The male has the inner spur of the two anterior tibiæ strongly dilated, and the fifth ventral one-half longer than the fourth and truncate at tip. The single specimen before me has no indication of locality, but is without much doubt from the region suggested.

82. **T. ænescens** Lec.—Proc. Acad. Nat. Sci., Phila., VI, p. 170 (Dasytes); l. c., 1866, p. 355 (Pristoscelis).

Narrow, convex, highly polished, deep black with a very feeble æneous lustre; legs black, the tibiæ and tarsi dark rufo-piceous;

antennæ blackish, the funicle slightly pale toward base; pubescence blackish, long and coarse, very sparse, erect or semi-erect and bristling, the marginal cilia of the elytra also black. Head four-fifths as wide as the prothorax, smooth throughout, finely and sparsely punctate, the frontal impressions large and distinct, approximate, the dividing convexity rather prominent; epistoma somewhat narrow and long; labrum a little wider than long, circularly rounded; eyes rather large and prominent; antennæ slightly longer than the prothorax, incrassate toward tip, the penultimate joints distinctly transverse. Prothorax three-fifths wider than long, the sides rounded at basal third thence feebly convergent and just visibly arcuate to the broadly rounded apical angles and more rapidly convergent and straight to the basal angles, which are very obtuse but scarcely at all rounded; apex and base equal, feebly arcuate; disk minutely and remotely punctate, not at all rugose at the sides. Elytra three-fifths longer than wide, slightly wider than the prothorax, parallel, rather strongly but evenly rounded at apex, very coarsely and sparsely but not very deeply and somewhat unevenly punctate. Abdomen very finely and sparsely cinereo-pubescent. Length 2.3 mm.; width 0.8 mm.

Southern California. The single example before me is a male, with the fifth ventral longer than the fourth and truncate at tip. This species resembles *lucidus* in form but is smaller, with a distinctly larger head, still coarser and sparser and especially feebler and less even elytral punctures, and may be known also by the absence of cinereous pubescence on the upper surface of the body.

83. **T. rusticus** n. sp.—Elongate, moderately convex, polished, black, the legs piceous; antennæ rufo-piceous, blackish toward apex; pubescence coarse, rather long, very sparse, subdecumbent and blackish, with numerous long and erect, black and bristling setæ. Head but little more than three-fourths as wide as the prothorax, convex, smooth throughout, finely and sparsely punctate, the frontal impressions rather small, apical and widely separated but distinct; epistoma rather long and somewhat narrow; slightly pale; labrum in great part pale, slightly wider than long, strongly rounded; eyes rather large but only moderately prominent and somewhat distant from the base; antennæ much longer than the prothorax, feebly incrassate, the penultimate joints distinctly transverse, fifth feebly dilated. Prothorax moderate in size, three-fifths wider than long, the sides perfectly parallel and just visibly arcuate, noticeably convergent and straight near the base, the angles very obtuse but distinct, not rounded and feebly reflexed; apical angles but slightly obtuse and extremely narrowly rounded; apex and base broadly and almost

equally arcuate; disk minutely and remotely punctate, not at all rugose laterally. *Elytra* three-fifths longer than wide, slightly wider than the prothorax, parallel and straight at the sides, the apex evenly and not very broadly rounded; disk coarsely, rather sparsely and somewhat unevenly punctate. *Abdomen* and legs rather finely and not densely cinereo-pubescent. Length 2.4 mm.; width 0.9 mm.

#### California.

The male above described has the fifth ventral simple, rather short and broadly truncate. Along the suture and on the flanks of the elytra a few cinereous hairs are sparsely scattered, but these are extremely inconspicuous in the two specimens before me, and, in case they should become denser by variation, the species may be readily known from *suturalis* by its much smaller size, narrower form, smaller, shorter and relatively narrower prothorax and relatively still coarser, though scarcely sparser, elytral punctures.

84. **T. politus** n. sp.—Subcylindrical, strongly convex, highly polished, deep black, the legs black; antennæ black, with the funicle slightly piceous toward base; pubescence fine and suberect, very sparse, blackish, the surface bristling also with very numerous long erect and black setæ, a few short but coarser cinereous hairs scattered narrowly on the elytral flanks toward base, the marginal cilia black throughout. *Head* four-fifths as wide as the prothorax, smooth, finely and sparsely punctate, the impressions rather large, elongate, widely separated but distinct; epistoma moderately transverse; labrum rounded; eyes rather large and prominent; antennæ a little longer than the prothorax, feebly incrassate, the penultimate joints distinctly transverse, fifth noticeably dilated. *Prothorax* notably convex; three-fifths wider than long, the sides parallel and strongly arcuate; basal angles very obtuse but not obliterated, the apical very obtuse; apex arcuato-truncate, the base visibly more arcuate; disk finely and remotely punctate, not rugose laterally. *Scutellum* finely and not very densely cinereo-pubescent. *Elytra* three-fifths longer than wide, very slightly wider than the prothorax, the sides subparallel; apex evenly and not broadly rounded, the sutural angles right and not rounded; disk coarsely, deeply and rather sparsely punctate, the interspaces smooth and polished. *Abdomen* thinly clothed with fine plumbeo-cinereous pubescence. Length 2.9 mm.; width 1.2 mm.

California (San Diego). Mr. Dunn.

The two males before me represent a species which may be known at once from *rusticus* by the strongly rounded sides of the prothorax, and, from *ænescens*, it may be distinguished by the less sparse and deeper elytral punctures. The fifth ventral is rather short and is broadly sinuato-truncate at apex.

85. **T. punctipennis** Lec.—Proc. Acad. Nat. Sci., Phila., 1866, p. 355 (Pristoscelis.)

Oblong, rather narrow and depressed, highly polished, deep black, the legs piceous-black; antennae dark piceous, the second joint slightly paler; pubescence rather fine, moderately long, decumbent, blackish and very sparse, slightly cinereous on the vertical flanks of the elytra toward base, the intermixed erect setae very sparse or wanting, the marginal cilia of the prothorax and elytra rather short and fimbriiform, dark in color. Head small, barely two-thirds as wide as the prothorax, finely and sparsely punctate, the eyes well developed; antennae moderate, the penultimate joints transverse. Prothorax small, one-half wider than long, arcuate at the sides toward base, gradually narrowed and less rounded anteriorly, the apex truncate and about equal to the base; basal angles very obtuse, the apical greatly deflexed and rounded; disk smooth, feebly reticulate but not rugose toward the sides, finely and sparsely punctate. Elytra three-fifths longer than wide, nearly one-third wider than the prothorax, parallel, slightly inflated behind, with the sides arcuate becoming straight near the base; apex evenly and not broadly rounded; disk subexplanate and with the edge serrulate at apex, rather finely but distinctly and very sparsely punctate. Abdomen polished, very coarsely and obsoletely reticulate, sparsely pubescent. Length 1.8 mm.; width 0.75 mm.

California (Sta. Catalina Island). A small and very distinct species, which seems to be most naturally associated with *ænescens*, in spite of the apparent absence of erect and bristling hairs. The above description refers to the female. The allusion to "pube cinerea" in the original description is very inexact, the hairs being dark and indistinct.

86. **T. stricticollis** n. sp.—Elongate, strongly convex, polished, black with an extremely feeble aneous lustre; legs piceous-black; antennae black, the funicle piceo-testaceous toward base; pubescence sparse, not very long, blackish and nearly erect, cinereous and subdecumbent on the prothorax toward the sides; marginal cilia coarse, blackish, moderate in length, regular and fimbriiform. Head two-thirds as wide as the prothorax, smooth, finely and sparsely punctate, the impressions rather small, widely separated but distinct; epistoma moderate in length, in great part pale luteo-flavate; labrum blackish, very pale toward tip, nearly as long as wide and strongly rounded; mandibles strongly arcuate; eyes rather large and prominent, not attaining the base; antennae slightly longer than the prothorax, feebly incrassate, the penultimate

joints transverse, fifth but slightly dilated. *Prothorax* only about one-third wider than long, the sides broadly arcuate near the base, moderately convergent and straight thence anteriorly, becoming sinuate behind the apical angles which are somewhat prominent laterally and not rounded; basal angles broadly obtuse but not altogether obliterated; apex broadly arcuate and somewhat bilobed, the base arcuate; disk finely and sparsely punctate, not rugose near the sides. *Elytra* scarcely three-fifths longer than wide, not visibly wider than the prothorax, nearly straight and parallel at the sides, the apex almost semi-circular; disk rather coarsely and strongly, somewhat sparsely punctate, the interspaces smooth and polished. *Abdomen* rather thinly cinereo-pubescent. Length 2.4 mm.; width 0.85 mm.

#### California.

The type of this species is a male, the fifth ventral being simple and truncate at apex. It departs widely from any other in the form of the prothorax, and may be recognized also by peculiarities of vestiture, but in other respects is wholly similar to the other species of the genus. A single specimen from an unrecorded locality in the State.

#### **CRADYTES** n. gen.

There are several important points of difference between this genus and *Trichochrous*, the chief of which refer to thoracic structure, the rounded and obsolete apical angles and correspondingly narrowed and advanced median parts of the apex, giving to this somite a facies which is distinctively peculiar. The side margins of the prothorax are strongly serrate, and the antennæ are relatively still shorter than in *Trichochrous*, broader and with the joints more serrate or asymmetric, to a much greater degree in *serricollis*, however, than in the other species. The ungual appendages are less constant and equal in *Cradytes* than in *Trichochrous*, and are united to the claws in only about basal half of their length. In other structural characters, including the form and extent of the epipleuræ, *Cradytes* is closely allied to *Trichochrous*. The three species may be readily differentiated as follows:—

- |   |                       |
|---|-----------------------|
| Body black, the elytra pale rufo-ferruginous..... | 1. <b>serricollis</b> |
| Body black throughout; smaller species.           |                       |
| Erect setæ of the elytra pale.....                | 2. <b>longicollis</b> |
| Erect setæ black; body very slightly stouter..... | 3. <b>serrulatus</b>  |

In geographical distribution *Cradytes* is practically limited to the arid regions of New Mexico and Arizona, but it probably extends southward into Mexico to some extent.



1. **C. serricollis** Lec.—Proc. Acad. Nat. Sci., Phila., 1866, p. 356 (Pristoscelis).

Oblong, strongly convex, polished, black, the elytra and legs throughout pale rufo-ferruginous; abdomen black; antennæ blackish, the funicle pale toward base; pubescence coarse, erect and very conspicuous though not dense, the erect hairs black anteriorly, intermixed with shorter and more decumbent pale hairs toward the sides of the pronotum, white on the elytra and intermingled with a few black hairs toward the suture and base; marginal cilia long and white throughout. Head three-fifths as wide as the prothorax, nearly smooth, strongly and rather sparsely punctured, the impressions feeble; epistoma rather long, with a thin and transversely impressed pale apical prolongation; labrum blackish, setose, strongly rounded at apex; eyes moderate in size but prominent and distant from the base; antennæ stout and strongly serrate, barely as long as the prothorax, the joints strongly transverse, inserted near their outer margins. Prothorax scarcely more than one-fourth wider than long, the sides parallel and feebly arcuate, oblique at apex, the latter arcuate and only two-thirds as wide as the base; basal angles obtuse but distinct, the apical wholly obliterated; margins strongly serrate especially before the middle; disk coarsely and deeply punctate, sparsely toward the middle, not rugose near the sides. Elytra two-thirds longer than wide, slightly wider than the prothorax, parallel, not very broadly rounded behind, strongly and rather sparsely punctate, the punctures gradually fine behind; epipleuræ narrow as in *Trichochrous*, dilated toward base. Length 5.0 mm.; width 2.0 mm.

New Mexico and Colorado. The male, from which the description is taken, has the fifth ventral truncate at apex and feebly sinuate toward the middle, and the inner spur of the anterior and middle tibiæ dilated. The ungual appendages do not seem to be quite as long as the claws, and are attached through only about basal half of the latter; they are also slightly unequal.

2. **C. longicollis** n. sp.—Elongate, parallel, rather cylindrically convex, somewhat shining, black, the tibiæ and tarsi slightly piceous; antennæ piceous-black, pubescence coarse, rather short and somewhat dense, semi-erect, even and cinereous, intermixed with numerous erect bristling setæ, which are shorter, denser and in great part pale on the elytra. Head three-fourths as wide as the prothorax, very feebly rugulose, strongly and rather closely punc-

tate, the impressions feeble; epistoma rather long, truncate, emarginate at the sides toward base as in *serricollis*; labrum about as long as wide, strongly rounded; eyes large and somewhat prominent; antennæ very much shorter than the prothorax, rather slender but rapidly and very strongly incrassate and compressed toward apex, the last three joints very wide and asymmetric, the eleventh as wide as long, tenth very strongly transverse. *Prothorax* fully as long as wide, the sides parallel and just visibly arcuate, gradually and broadly arcuate and convergent at apex, the angles completely obliterated, the true apical margin not one-half as wide as the base, the latter broadly arcuato-truncate; basal angles obtuse and rather blunt but easily distinguishable; disk rather finely and sparsely punctate, the lateral edges strongly serrate especially toward apex. *Elytra* three-fifths longer than wide, slightly wider than the prothorax and distinctly less than twice as long, parallel and straight at the sides, not broadly rounded at apex, not very coarsely but strongly and somewhat densely punctured. Under surface moderately densely clothed with similar cinereous pubescence. Length 2.8–3.8 mm.; width 0.95–1.5 mm.

#### Arizona.

In the above described male the corneous copulatory sheath is large and cylindrical, with the lower surface produced in a fine slender point, the upper or posterior surface coriaceous and concave, the efferent duct projecting between two wing-like plates which partially close the orifice. The prothorax of the male is more elongate than in any other dasytide form known to me, except *Mecomyceter omalinus*.

In the female the form is quite different, the prothorax being much smaller, nearly one-fourth wider than long and narrowed from base to apex, broadly rounded and scarcely at all serrate at the sides, the elytra longer though similar in shape, one-half wider than the prothorax and two and one-half times as long. Numerous specimens are before me.

3. **C. serrulatus** Lec.—Proc. Acad. Nat. Sci., Phila., 1866, p. 356 (*Pristoscelis*).

Oblong, stout, convex, black, moderately shining; legs black, the tibiæ and tarsi rufo-piceous; antennæ black, the funicle testaceous toward base, the two basal joints black; pubescence very short, coarse, rather sparse, cinereous and intermixed with numerous long coarse and erect black hairs; marginal cilia of the prothorax very long black and bristling, of the elytra much shorter and nearly cinereous. Head two-thirds as wide as the prothorax, strongly and sparsely punctate; epistoma long and rather narrow, smooth; labrum long, strongly rounded; eyes

large, moderately convex, not attaining the base; antennæ much shorter than the prothorax, rapidly incrassate, the penultimate joints strongly transverse and asymmetric. Prothorax one-fourth wider than long, feebly narrowed from base to apex, with the sides just visibly arcuate, slightly serrate anteriorly, the apical angles broadly rounded and obliterated; basal angles also broadly rounded and undefined; disk rather finely but strongly, somewhat closely punctured especially toward the sides. Elytra large, three-fifths longer than wide, one-third wider than the prothorax, parallel, feebly inflated behind, the apex almost semi-circularly rounded; punctures moderately coarse, strong and rather close-set. Abdomen sparsely clothed with longer decumbent cinereous pubescence. Length 3.9 mm.; width 1.6 mm.

Arizona. This species is allied to *longicollis*, but differs, when compared with the corresponding sex, in having the erect hairs of the elytra sparser and black, and the short hairs shorter, coarser, posteriorly bent and more decumbent. The male is probably narrower than the female described above, and with a more elongate and more strongly serrate prothorax.

#### **SYDATOPSIS** n. gen.

Aberrant antennal structure constitutes the chief differential feature of this genus, nearly all the other characters being essentially those of *Trichochrous*. The antennæ in the male are distinctly longer than the head and prothorax combined, rather narrow and not incrassate, the joints strongly serriform, longer than wide, strongly narrowed toward base and clothed sparsely with long pale hairs, the eleventh narrower than the tenth, elongate and pointed toward base and apex from the middle, the fifth very slightly dilated. The unguual appendages are long and well developed.

1. **S. longicornis** n. sp.—Oblong, strongly convex, polished, black, the elytra feebly æneo-piceous, with the apical margin pale; abdomen slightly pale at tip; legs pale rufo-ferruginous throughout; antennæ pale testaceous, the eleventh joint somewhat obscure; pubescence rather long, coarse, dense and pale luteo-cinereous, intermingled with numerous long erect and bristling pale setæ, which are mixed with a few black hairs anteriorly; marginal cilia long, bristling and irregular, pale in color. Head barely three-fourths as wide as the prothorax, convex, strongly, densely and rugosely punctate, smooth toward the middle anteriorly, the impressions obsolete; epistoma long, impunctate and gradually pale; labrum long, pale and strongly rounded; eyes moder-

ate in size, convex and prominent, not attaining the base. *Prothorax* one-half wider than long, the sides broadly arcuate behind, gradually slightly convergent and straighter anteriorly, the apex arcuato-truncate, slightly narrower than the base which is but slightly more arcuate; all the angles obtuse and rounded; disk finely, sparsely punctate, the interspaces smooth and polished throughout. *Elytra* short, not quite one-half longer than wide, slightly but distinctly wider than the prothorax, very obtusely rounded at apex, the sides nearly parallel and straight; punctures rather fine but strong and somewhat close-set. *Abdomen* shining but distinctly cinereo-pubescent, the legs and tarsi long and slender. Length 2.3 mm.; width 0.9 mm.

#### Lower California.

The single male type in my cabinet has the fifth ventral broadly truncate, the genital segment broadly sinuato-truncate, flat and finely canaliculate along the middle, and the inner spur of the two anterior tibiæ broadly dilated, thickened and as usual very obtuse at apex.

#### SYDATES n. gen.

The single representative of this genus is a rather stout oblong insect, which is intermediate in some of its characters between *Trichochrous* and *Listrus*, but which differs from both in its long and strongly serrate antennæ and in the form of the ungual appendages, these being acutely pointed and leaving nearly one-half of the inner claw free. The anterior tibiæ have a few long and slender bristle-like spines along the outer side, which are much less conspicuous than in *Trichochrous*, and the general habitus and ornamentation of the body is remindful of *Listrus*. The epipleuræ are very narrow and indistinct, slightly wider toward base and with their plane inclined upward externally.

1. **S. zonatus** n. sp.—Oblong, strongly convex, polished, black; legs pale rufo-ferruginous, with the thighs rather stout and in great part blackish; antennæ pale, gradually blackish toward apex, the basal joint also obscure; pubescence rather dense, moderate in length, even, without intermixed erect hairs, cinereous but broadly blackish along the middle of the pronotum and in a broad fascia at base and apical fourth of the elytra, the fasciæ narrowly interrupted along the suture. *Head* two-thirds as wide as the prothorax, flat, finely and sparsely punctate and feebly subrugulose, the frontal impressions large, approximate and distinct; epistoma very short; labrum short, transverse and feebly arcuato-truncate; eyes moderately large and somewhat prominent; antennæ distinctly longer than the head and prothorax, stout, filiform, the joints slightly longer than wide, asymmetric and strongly narrowed toward base, the inner obtuse projections densely bristling with short stiff setæ. *Prothorax* four-fifths wider than long, the sides rather strongly rounded near basal

third, thence convergent and almost straight to the apex and base, the former but slightly narrower than the latter and both very feebly arcuate; basal angles very obtuse but not wholly obliterated; lateral edges distinctly fimbriate but not serrulate; disk finely but strongly, not very closely punctate, the punctures becoming gradually close and feebly rugose toward the sides. *Elytra* but slightly more than one-half longer than wide, only slightly wider than the prothorax, the sides parallel and straight; apex evenly rounded; disk somewhat coarsely and closely punctured and feebly rugose, the interspaces polished. Under surface rather densely clothed with coarse cinereous pubescence. Length 2.6–3.0 mm.; width 1.0–1.25 mm.

Texas (El Paso). Mr. Dunn.

The male above described has the fifth ventral short and transversely truncate, and the inner spur of the anterior and middle tibiae dilated. The female differs but slightly, having the head distinctly and the prothorax slightly smaller, and the antennae more slender though only a little shorter; the female seems also to have the legs a little more slender and pale rufous throughout. Five specimens.

#### **LISTRIMIMUS** n. gen.

The type of this genus is a species remarkably distinct in habitus because of its opaque sculpture, dense, even and closely appressed pubescence, feebly constricted prothorax with acute and everted basal angles, and small prominent eyes situated at a considerable distance from the base of the head, the neck being narrowed posteriorly. The antennae are rather long and slender, though distinctly incrassate toward apex. The anterior tibiae are cylindrical, with appressed pubescence and without trace of external spines or setae. The epipleurae are narrow, vanishing far before the apex but with their plane almost horizontal throughout, and the ungual appendages are as long as the claws, subequal and detached from the outer third or fourth of the claw as in *Trichochrous*. The remaining characters are those of the tribe in general, the maxillary palpi being rather stouter than usual and the tarsi long and filiform.

1. **L. sericatus** n. sp.—Elongate, suboval, strongly convex, black; legs blackish-piceous, the under side of the femora rufous, more broadly toward base; antennae black, testaceous toward base, the basal joint in great part blackish; head and pronotum opaque, densely and evenly rugose with small irregular and anastomosing punctures, the elytra polished and finely but closely punctured; pubescence whitish-cinereous, closely decumbent, even, coarse, moderate in length and extremely dense, without trace of erect hairs.

*Head* three-fourths as wide as the prothorax, constricted at base, the eyes small and very prominent; frontal impressions feeble and widely separated; epistoma very short, with a thin pale margin; labrum pale, short, transversely rounded; antennæ slender, feebly incrassate, subequal in length to the head and prothorax, the outer joints rather longer than wide, sixth distinctly smaller than the fifth or seventh. *Prothorax* scarcely one-third wider than long, the sides feebly convergent from base to apex, broadly arcuate, becoming sinuate toward base and apex, the broad subapical constriction extending entirely across the disk; basal angles acute, prominent and everted, the apical rather blunt; apex arcuato-truncate, the base with a broad arcuate lobe; disk subcylindrically convex, very declivous at the sides and with an elongate foveiform impression on the median line near the base; lateral edges not serrulate and with a very decumbent and dense fringe. *Elytra* three-fifths longer than wide, one-half wider than the prothorax, the sides parallel and nearly straight; apex evenly rounded; humeri tumid. Under surface more finely and less densely pubescent, the hairs less closely decumbent. Length 3.0 mm.; width 1.0 mm.

Nevada (Reno). Mr. Wickham.

The type is a male, having the fifth ventral short and transversely truncate and the genital segment sinuato-truncate at tip and broadly impressed at the middle of the disk. The tibiæ have a terminal fringe of short spinules internally and externally, but I am unable to detect the usual two larger spurs.

I have before me a female, also from Nevada, which may be referred to this species for the time being, although the differences are extraordinary. The sculpture of the head and pronotum is much coarser and the pubescence of the elytra finer and twice as sparse. The pronotum has a strong impressed line parallel to each lateral edge and at some distance from it, not attaining base or apex and of which there is no trace in the male, and the sub-basal fovea of that sex is wanting.

#### **ADASYTES** n. gen.

Although not differing much from certain forms of *Trichochrous* in general habitus, the type of this genus is in reality more closely allied to *Listrus*, the anterior tibiæ being completely devoid of short stout spinules; these are replaced by a few long slender black and anteriorly inclined bristles. From *Listrus*, however, it differs completely in facies and in the even and non-serrulate edges of the prothorax. The hypomera have a large rounded and deep impression near the inner edge anteriorly, equally developed on each side in the type and probably a normal

character, of which it is impossible at present to state the significance.

1. **A. laciniatus** n. sp.—Narrow, parallel and rather convex, polished, black, the head and pronotum with a dark bluish-metallic lustre, the elytra slightly piceous; femora black, the tibiae and tarsi rufo-piceous; antennae black, with the second joint testaceous; pubescence rather long but sparse and semi-erect, blackish anteriorly, cinereous toward the sides of the pronotum, the marginal cilia of this part well developed, dense even and black, brownish-black on the elytra, with a few cinereous hairs scattered along the suture and on the flanks, the marginal cilia rather sparse and pale, the upper surface devoid of long erect setae. *Head* fully three-fourths as wide as the prothorax, nearly smooth, finely and sparsely punctate, the entire front between the eyes to the anterior margin broadly concave, the bottom of the concavity feebly convex in the middle anteriorly, epistoma short and transverse; labrum small, transverse, pale, broadly rounded; mandibles pale in the middle; eyes large and prominent, not quite attaining the base; antennae about one-third longer than the prothorax, feebly incrassate, the outer joints but slightly transverse and scarcely asymmetric. *Prothorax* transversely elliptical, three-fourths wider than long, parallel and strongly, evenly rounded at the sides; all the angles broadly rounded; apex and base very slightly arcuate, the former just visibly the narrower; disk finely, sparsely punctate, coarsely but feebly reto-rugose toward the sides. *Elytra* nearly two-thirds longer than wide, equal in width to the prothorax, parallel and straight at the sides, evenly and not obtusely rounded at apex, the sutural angles slightly blunt; punctures coarse and not very close-set, much finer toward tip. Under surface thinly cinereo-pubescent. Length 2.7 mm.; width 0.9 mm.

California (San Diego). Mr. Dunn.

The unique male type has the fifth ventral truncate at apex and somewhat impressed on the disk from side to side in a posteriorly arcuate area; the inner spur of the anterior and middle tibiae is dilated, with the tip obtuse but acutely pointed at the middle of the apex.

#### **LISTRUS** Motsch.

The genus *Listrus*, as here considered, is an extensive and very homogeneous aggregate, characterized by an elongate and subparallel convex body, generally sparse and variegated vestiture without intermixed setae, slender tarsi in both sexes, with the basal joint of the posterior slightly longer than the second, the fifth somewhat dilated toward tip and canaliculate above at apex as usual throughout the family, the anterior tibiae slender, cylindrical, usually with closely decumbent ashy pubescence and only

occasionally with two or three very slender distant external spines, these being completely obsolete as a rule.

Antennæ short, feebly incrassate, only slightly though distinctly serrate, with the first joint always much dilated and darker in color, the fifth larger than the fourth or sixth, and the eleventh evenly elongate-ovoidal and obtusely acuminate. The prothorax is dilated toward base, with the lateral edges minutely serrulate and having a close-set even fringe of short posteriorly and superiorly recurved setæ, which are almost invariably pale ashy white in color, the apical angles always very obtuse. Epipleuræ very narrow but dilated toward base, with their plane strongly inclined upward throughout. The ungual appendages are thick, equal and fully as long as the claws, the apical third or fourth of which is free.

The author of the genus did not seem to have a very clear conception of its real scope, as the first species which he assigned to it—*constricticollis* (= *constrictus* Lec.)—is generically quite distinct from the species of LeConte and Mannerheim, which he subsequently states should be included, and which alone agree with his generic diagnosis in having the sides of the prothorax serrulate. The other two species described by Motschulsky have not been identified and are probably also generically different from *rotundicollis*, *canescens*, etc. I agree with LeConte, however, that it is probably the best course to regard *Listrus* as constituted below, and not as the equivalent of *Eschatocrepis* Lec. Our species are numerous, and those before me may be quite readily distinguished among themselves as follows:—

Interspaces between the pronotal punctures, finely, evenly and closely punctulato-rugulose.

Prothorax broadly arcuato-truncate at apex, the latter fully as wide as the head.....1. **rotundicollis**

Prothorax much more narrowed anteriorly, the apex narrower than the head, sinuato-truncate and with more distinct angles; pubescence less abbreviated.....2. **interstitialis**

Interspaces smooth or coarsely rugose.

Elytra without a broad denuded fascia at the middle .....2

Elytra with a broad dark quasi-denuded transverse fascia at the middle; small species.....9

Elytra with variegated pubescence and a conspicuous rhomboidal quasi-denuded fascia at apical fourth; small species.....12

2—Larger species, 3 mm. or more in length, the denuded areas of the elytra in the form of isolated spots or very uneven and interrupted fasciæ .....3



- Smaller species, 3 mm. or less in length.....6
- 3**—Pubescence noticeably long.....4
- Pubescence short.....5
- 4**—Fifth ventral of the male truncate but not otherwise modified. California.  
 Elytral punctures coarse and rather sparse .....3. **motschulskii**  
 Elytral punctures smaller and denser; body more elongate; eyes more prominent in both sexes.....4. **montanus**
- Fifth ventral broadly emarginate at apex, the pubescence bristling and black posteriorly. Rocky Mountains.....5. **interruptus**
- 5**—Lateral cilia of the prothorax very short and nearly white as usual.  
 Elytral punctures coarse and sparse; body more obese and suboval.  
 Prothorax subequal in width to the elytra, shining and sparsely punctate.....6. **amplicollis**  
 Prothorax distinctly narrower than the elytra, more narrowed anteriorly, subopaque and very densely punctate.  
 Hypomera coarsely rugose; antennæ stout toward apex.  
7. **densicollis**  
 Hypomera more finely rugose; antennæ slender.....8. **plenus**  
 Elytral punctures smaller and feebler; body less obese.  
 Elytral punctures sparse, the prothorax short and transverse.  
9. **subæneus**  
 Elytral punctures close-set; prothorax longer; body narrower and more parallel.....10. **maculosus**
- Lateral cilia of the prothorax much longer, coarser, bristling and dark in color.....11. **pardalis**
- 6**—Elytra uniformly clothed with ashy hairs; antennæ with a distinct three-jointed club.....7
- Elytra with confusedly denuded spots, generally with a more or less distinct transverse fascia near the apex.....8
- 7**—Ashy pubescence distinct and moderately long; pronotum densely sculptured and dull.  
 Elytral pubescence very dense; prothorax feebly transverse and much narrower than the elytra .....12. **senilis**  
 Elytral pubescence distinctly sparser, the body smaller and less elongate.  
 Penultimate antennal joint of the male strongly transverse; prothorax narrower than the elytra.....13. **clavicornis**  
 Penultimate joint nearly as long as wide; prothorax subequal in width to the elytra.....14. **uniformis**
- Ashy pubescence very short and extremely sparse; pronotum sparsely and distinctly punctured .....15. **obscurellus**
- 8**—Tibiæ and tarsi clear rufous.....16. **extricatus**
- Tibiæ and tarsi more obscure, black to dark rufo-piceous in color.  
 Elytra with two tolerably well marked denuded fasciæ behind the middle.  
 Male with the fifth ventral black velvety-pubescent.....17. **canescens**  
 Male without modified pubescence on the fifth ventral...18. **difficilis**  
 Elytra with the subapical fascia alone distinct, the other resolved into two strongly V-shaped spots; pubescence dense and very coarse; pronotal punctures distinct, the interspaces smooth.....19. **fideli**

- Elytra with the vestiture confused and very indefinitely mottled; pronotum densely punctato-rugose.  
 The elytral vestiture coarse and extremely dense.....20. **tritatus**  
 The elytral vestiture sparse; prothorax much shorter and more transverse .....21. **confusus**  
**9**—Legs black or blackish.....10  
 Legs red.....11  
**10**—Elytra with the pubescence confusedly maculate toward base.  
 Prothorax sparsely punctate .....22. **variegatus**  
 Prothorax shorter and densely punctate.....23. **incertus**  
 Elytra with three almost even transverse fasciæ of pale hairs.  
 24. **annulatus**  
**11**—Elytra with three fasciæ of pale hairs.....25. **rubripes**  
 Elytra with unevenly distributed pubescence toward base.  
 Pronotum longer, rather sparsely and distinctly punctate ....26. **luteipes**  
 Pronotum shorter, transverse, densely punctato-rugose.  
 White hairs of the elytra slender as usual.  
 Prothorax much narrower than the elytra, with subangulate sides.  
 27. **concurrents**  
 Prothorax about as wide as the elytra, with rounded sides.  
 28. **balteellus**  
 White hairs elongate-lanceolate and somewhat squamiform, very dense in a narrow transverse fascia at apical third.....29. **famelicus**  
**12**—Body rather broad, dilated behind in the female ..... 30. **ornatulus**

The original descriptions of the two unidentified species of Motschulsky are appended :—

“*Alatus, elongato-subovatus, subconvexus, nitidus, fortiter punctatus, brevissime sparsim subargenteo æqualiter setulosi, supra nigro-æneus, subtus niger, antennarum articulis 2-4, labro, tibiæ apice tarsisque plus minusve testaceo-piceis; capite punctato, fronte inter antennis tuberculo nitido notato, oculis subprominulis; thorace subconvexo, fere transverso, punctato, antice attenuato, angulis omnes rotundatis, lateribus postice distincte crenulatis; elytris fortiter punctatis, thorace paulo latioribus, subovatis, postice arcuato-atenuatis; femoribus subincrassatis. Long.  $1\frac{2}{3}$  l.—lat.  $\frac{1}{2}$  l. Ross. [Sonoma Co.]”*

31. **punctatus**

“*Alatus, elongato-subovatus, subconvexus, nitidus, punctatus, sparsim cinereo setosus, supra nigro-æneus, subtus niger, tibiis rufo-testaceis, labro tarsisque infuscatus, antennis femoribusque nigerrimis; fronte inter antennis transversim carinulato, carinula valde nitida; thorace transverso, antice angustato, angulis anticis distinctis, posticis rotundatis, lateribus subcrenulatis, longissime setosis; elytris punctatis, cinereo setosis, subovatis, postice arcuato-atenuatis. Long.  $1\frac{1}{6}$  l.—lat.  $\frac{1}{3}$  l. Ross.”*.....32. **tibialis**

The subjoined remarks add little or nothing to the descriptions and need not be repeated. No species of *Listrus* having the pu-

bescence evenly distributed, as indicated by these descriptions, is known to me from the true Pacific coast faunal province.

The statement in the table of LeConte (Proc. Acad., 1866, p. 357), that the prothorax in *canescens*, *difficilis* and *rotundicollis* is not wider than long is very much in error, and is another example of a singular personal equation previously alluded to (Col. Not. III, p. 205), by which the author quoted continually overestimates the length of this part of the body in terms of its width; at the same time, it should be said that this overestimation is more or less general among systematic writers, and results largely from a natural cerebral bias which it is difficult to explain satisfactorily; it is only mentioned in the present connection because of its excessive amount.

1. **L. rotundicollis** Lec.—Proc. Acad. Nat. Sci., Phila., VI, p. 170 (Dasytes); l. c., 1866, p. 358 (Listrus).

Elongate-oval, strongly convex, polished throughout, black with a dark steel-blue metallic reflection; legs and antennae black throughout; pubescence very short, decumbent, coarse and sparse, denuded near the suture behind the middle of each elytron, longer and finer beneath. Head three-fifths as wide as the prothorax, rather sparsely punctate, broadly biimpressed anteriorly. Prothorax nearly one-half wider than long, widest slightly behind the middle, the sides arcuate with the cilia strongly recurved; apex four-fifths as wide as the base, broadly arcuate, the angles obtuse and decidedly blunt; disk evenly convex, deeply and sparsely punctate, the interspaces flat and finely and closely rugulose, becoming coarsely rugose only near the sides. Scutellum densely albido-pubescent. Elytra three-fourths longer than wide, only slightly wider than the prothorax, the sides parallel and nearly straight, becoming rather abruptly strongly convergent and feebly arcuate in apical third, the apex conjointly narrowly rounded; disk very coarsely but not densely punctate, less coarsely so toward apex. Under surface reticulate but not distinctly punctate. Length 2.8 mm.; width 1.0 mm.

California (San José)—Cab. LeConte. The above outline is taken from the female, in which sex the fifth ventral is much longer than the fourth, truncate at apex and unmodified on the disk. In the male the fifth segment is, according to LeConte, somewhat excavated longitudinally, the excavation fringed with black velvety pubescence.

2. **L. interstitialis** n. sp.—Elongate-oval, convex, polished, black, the elytra with greenish, the pronotum with subcupreous metallic reflection; legs black; antennæ black, the second joint and the third less distinctly testaceous; pubescence moderately short, sparse, denuded on each elytron in two large spots in basal half and several confused spots behind the middle especially toward the suture. *Head* three-fifths as wide as the prothorax, sparsely but deeply perforato-punctate, feebly granulato-reticulate, obsoletely biimpressed toward apex; eyes moderately prominent; antennæ quite distinctly longer than the prothorax, rather slender, feebly incrassate. *Prothorax* scarcely more than one-third wider than long, widest near basal two-fifths; sides broadly rounded toward base, thence strongly convergent and nearly straight to the apex, the latter sinuato-truncate and scarcely two-thirds as wide as the base; angles obtuse but scarcely at all rounded; disk evenly convex, deeply but sparsely perforato-punctate, the interspaces flat and finely and evenly granulato-rugose, coarsely rugose near the sides. Scutellum densely clothed with white pubescence. *Elytra* fully four-fifths longer than wide, slightly wider than the prothorax, the sides parallel and nearly straight, rather rapidly parabolic in less than apical third; disk coarsely, deeply punctate, somewhat rugose by oblique light, the punctures well separated, smaller toward apex. Under surface finely but strongly rugose, the abdomen reticulate with fine lines toward apex. *Legs* moderate, the hind tarsi subequal in length to the tibiae. Length 3.3 mm.; width 1.2 mm.

California (Sonoma Co.).

This species and the preceding are distinguished from all others of the genus by the peculiar sculpture of the pronotum, and *interstitialis* differs from *rotundicollis* in its longer and less convex elytra, longer pubescence, color of the antennæ and peculiarities of thoracic structure previously stated. It is represented by a single female specimen.

3. **L. motschulskii** Lec.—Proc. Acad. Nat. Sci., Phila., 1866, p. 357; *canescens* Lec. nec Mann.: l. c., VI, p. 170 (Dasytes).

Subparallel, elongate, moderately stout and convex, polished and with a dark bluish-metallic reflection; pubescence decidedly long, moderately coarse and sparse, rather indefinitely denuded in numerous large rounded spots on the elytra. Head slightly more than one-half as wide as the prothorax, rather closely perforato-punctate, broadly and distinctly biimpressed anteriorly; antennæ one-third longer than the prothorax, rather slender, black throughout. Prothorax one-half wider than long, widest at basal two-fifths, the sides strongly serrulate, rounded behind, convergent and straight anteriorly, the apex feebly arcuato-truncate, two-thirds as wide as the base, the angles very obtuse but distinct;

disk deeply and rather closely punctate, the interspaces polished and nearly smooth, abruptly coarsely rugose in lateral fourth. Elytra scarcely twice as long as wide, slightly wider than the prothorax, parallel, parabolic in apical third, rather sparsely punctate, the punctures not very strong and moderate in size. Legs somewhat stout, black, picescent toward apex. Length 3.0–3.75 mm.; width 1.0–1.3 mm.

California. One of the largest species of the genus and readily distinguishable by its long pubescence. The description is drawn from the female, for more advantageous comparison with others represented by that sex alone. The male is, as usual, smaller and narrower, with the head three-fourths as wide as the prothorax and with slightly more prominent eyes, the fifth ventral unmodified on the disk and broadly sinuato-truncate at apex, the genital segment transversely oval, flat and completely unmodified on the disk but clothed with longer blacker and more erect hairs; the fifth ventral of the female is longer and slightly deflexed at the apex.

4. **L. montanus** n. sp.—Elongate-oval, strongly convex, polished with a feeble viridi-æneous lustre; pubescence long and rather dense, the elytra with rounded and widely isolated denuded spots which are less evident toward base. *Head* nearly three-fourths as wide as the prothorax, with the eyes somewhat prominent; punctures moderate in size, close-set, the interspaces with feeble scattered dents; frontal impressions feeble; antennæ rather long, about one-half longer than the prothorax, piceous-black, with the second joint evidently somewhat pale. *Prothorax* one-half wider than long, outlined as in *interruptus*, but with the sides more convergent anteriorly, the apex relatively not quite so wide and the apical angles obtuse but scarcely at all rounded; disk rather closely punctate, the interspaces with small indents, especially toward base and apex, coarsely rugose laterally. *Elytra* nearly twice as long as wide, distinctly wider than the prothorax, parallel, obtusely parabolic in apical third, moderately coarsely, subrugosely and decidedly densely punctate. *Legs* moderately slender, black, the tarsi picescent. Length 3.5–3.6 mm.; width 1.2–1.25 mm.

California (Dunsmuir, Siskiyou Co.). Mr. Wickham.

The four specimens before me represent a species somewhat allied to *interruptus*, but differing in its larger size, longer, more finely and densely punctate elytra, and in the sexual characters of the male, the fifth ventral in that sex being broadly and very feebly sinuato-truncate and completely unmodified on the disk, with the vestiture closely decumbent throughout. The descrip-

tion is taken from the female, which is shorter and thicker in body than the male but not larger in size.

5. **L. interruptus** Lec.—Proc. Acad. Nat. Sci., Phila., VI, p. 357.

Elongate-oval, strongly convex, highly polished and with a feeble aneous lustre; interstitial spaces on the head and pronotum polished and without trace of reticulation; pubescence long, moderately coarse, sparse, denuded in rounded spots on the elytra. Head about three-fifths as wide as the prothorax, rather finely and somewhat closely perforato-punctate, broadly biimpressed toward apex; antennæ distinctly longer than the prothorax, rufo-piceous, the basal joint black, second palest. Prothorax one-half wider than long, widest two-fifths from the base; sides rounded posteriorly, convergent and straighter toward apex, the latter broadly arcuato-truncate and almost as wide as the base; angles very obtuse and blunt; disk not very coarsely, deeply, moderately closely punctate, coarsely reto-rugose as usual in rather less than lateral fourth. Elytra three-fourths longer than wide, distinctly wider than the prothorax, acutely ogival in apical third, coarsely and deeply punctate, the punctures separated by about their own widths, finer toward apex. Legs stout, the tarsi rufescent, the posterior distinctly shorter than the tibiæ. Length 2.9–3.5 mm.; width 1.0–1.25 mm.

Nebraska to California. The description is drawn from the female, the male being narrower, with relatively much larger head and with the tips of the elytra less acute. The fifth ventral of the male is broadly but strongly sinuato-truncate at apex, flattened on the disk and clothed with long erect and bristling hairs, which become black in apical half. This species extends westward to the crests of the Sierras in California, but does not descend the western slope of the mountains.

6. **L. amplicollis** n. sp.—Elongate-oval, moderately convex, highly polished throughout and with a greenish-brassy lustre above; legs and antennæ black, the second joint of the latter piceo-testaceous; pubescence short, very sparse, rather coarse, confusedly denuded in large anastomosing spots on the elytra; interspaces of the head and pronotum polished and with small feeble and widely distant punctures. Head barely three-fifths as wide as the prothorax, not very densely punctate, strongly biimpressed anteriorly; antennæ distinctly longer than the prothorax, moderately stout toward apex. Prothorax strongly transverse, three-fourths wider than long, rounded on the

sides toward base, strongly narrowed to the apex which is broadly arcuato-truncate, fully as wide as the head and distinctly narrower than the base; angles very obtuse but only slightly rounded; disk strongly but rather sparsely punctate, becoming rugose only in lateral sixth and with a subimpunctate area in the middle toward base. Scutellum densely pubescent. *Elytra* four-fifths longer than wide, scarcely wider than the prothorax, parallel, parabolic in apical third or fourth, coarsely, deeply and rather sparsely punctate. *Legs* moderately long, the hind tarsi much shorter than the tibiae. Length 3.3 mm.; width 1.2 mm.

California (San Francisco). Mr. Dunn.

The single type is a female, having the fifth ventral rather long with the surface feebly reflexed at apex, the latter bristling with dense pubescence. The two basal joints of the hind tarsi are subequal in length, but in another female, which I took at San Francisco, the basal joint is distinctly longer than the second, and, as the prothorax is much less transverse, it probably represents a closely allied but distinct species.

This species is distinguishable at once from *motschulskii*, with which alone it can be confounded, by its much shorter pubescence, sparser and coarser punctures of the pronotum and other characters.

7. ***L. densicollis*** n. sp.—Stout, oblong-oval, somewhat depressed above, polished, black with a greenish-brassy lustre; legs and antennae black, the second joint of the latter feebly picescent; pubescence short, sparse, cinereous, not very persistent, denuded in large indefinite patches on the elytra. *Head* three-fifths as wide as the prothorax, densely punctate, somewhat dull, the interspaces polished though feebly rugose; frontal impressions distinct; eyes moderate and at a considerable distance from the base; antennae only very little longer than the prothorax, the tenth joint one-half wider than long. *Prothorax* one-half wider than long, widest at basal third, where the sides are rather broadly and evenly rounded, thence strongly convergent and feebly arcuate to the apex, the latter truncate and scarcely narrower than the pedunculate base; apical angles very obtuse and rounded; lateral serrules strong; disk somewhat finely but deeply and closely perforato-punctate, the intervals flat and feebly, sparsely punctulate, only slightly wider than the punctures; rugose area occupying rather more than lateral fourth. *Elytra* oblong, two-thirds longer than wide, fully one-third wider than the prothorax, parallel, parabolic in apical third; humeri tumid and prominent; punctures rather coarse deep and sparse. *Abdomen* alutaceous, rather strongly but finely reticulate and punctulate, the legs moderately long, the hind tarsi much shorter than the tibiae with the basal joint but slightly longer than the second. Length 3.2–3.8 mm.; width 1.2–1.4 mm.

California (Napa Co.).

Described from the female and the male is still unknown. This is a distinct form, readily identifiable by the dull and densely sculptured pronotum, with unusually strong lateral serrulation, broad form and coarse sparse elytral punctures. Three specimens.

8. **L. plenus** n. sp.—Elongate-oval, strongly convex, polished, black, without metallic lustre; legs throughout and antennæ black, the second joint of the latter piceous; pubescence short, sparse, feebly persistent and denuded in large irregular areas on the elytra. *Head* fully three-fourths as wide as the prothorax, finely but deeply, sparsely perforato-punctate, the interspaces flat and somewhat rugose especially toward the eyes, the latter rather large but not prominent and situated near the base; frontal impressions broad and distinct; antennæ slender, quite distinctly longer than the prothorax, the tenth joint about as long as wide. *Prothorax* two-fifths wider than long, the sides evenly and moderately convergent and feebly arcuate from near the base to the obtuse and somewhat rounded apical angles; apex broadly arcuato-truncate and wider than the pedunculiform part of the base, which is more pronounced than usual; disk widest at basal third, moderately coarsely, deeply and very closely perforato-punctate, scabrous and opaque in lateral fourth; punctures separated by barely their own dimensions, the narrow interspaces sparsely and feebly punctulate. *Elytra* three-fourths longer than wide, fully one-third wider than the prothorax, parallel, acutely parabolic in apical third, coarsely and rather sparsely punctate, much more finely so toward apex. Length 3.0 mm.; width 1.2 mm.

Vancouver Island.

The single female type represents a species which cannot readily be confounded with any other known to me, being allied to *densicollis* only in the very close punctuation of the pronotum, but differing remarkably in its relatively larger head and very much more slender antennæ; the sides of the prothorax are less convergent anteriorly than in *densicollis*, as might be inferred from the large head.

9. **L. subæneus** n. sp.—Moderately elongate and convex, polished, with feeble cupreo-æneous lustre; legs throughout and antennæ black, the second joint of the latter feebly testaceous; pubescence moderately short, sparse, denuded in large spots on the elytra and readily removable. *Head* three-fourths as wide as the prothorax, the eyes somewhat prominent; punctures fine and rather sparse; frontal impressions widely separated, very deep and less diffuse than usual; antennæ slender, very much longer than the prothorax, the tenth joint about as long as wide and slightly asymmetric. *Prothorax* short, rather more than one-half wider than long, widest near basal third, the sides moderately convergent, becoming straight in apical half, distinctly serrulate; apex broadly arcuato-truncate, much wider than the pedun-



culiform part of the base, the apical angles widely rounded; disk finely, not very densely punctate, opaque and scabrous in lateral fourth; interspaces coarsely, sparsely and feebly indented. *Elytra* three-fourths longer than wide, slightly wider than the prothorax, parallel, parabolic in apical third, the humeri obtusely prominent; punctures rather fine and sparse. *Legs* moderately long, the hind tarsi slender, only slightly shorter than the tibiae. Length 3.1–3.7 mm.; width 1.1–1.3 mm.

California (Napa and Sonoma Cos.).

The punctures of the head and pronotum are much more shallow than usual. A specimen before me, assumed to be the male of the above-described female, has the head relatively only slightly larger and the eyes only a little more prominent, the fifth ventral much shorter, with its tip truncate, feebly deflexed and with a broadly obtuse median cusp, the surface with a small deep rounded fovea at the middle but without erect hairs, the genital segment not visible, but with the under surface of the dorsal pygidium largely exposed behind.

The male modification of the fifth segment is similar to that indicated by LeConte for his *difficilis* (Proc. Acad., 1866, p. 358), but several species were included by the author under that name, and the male of the true *difficilis* has no such medial fovea, as can be proved by a large series taken by the writer in the vicinity of San José.

10. **L. maculosus** n. sp.—Elongate, parallel, narrow and convex, polished, with a very faint bluish-metallic lustre; pubescence short, rather abundant and persistent, denuded in large isolated spots on the elytra, these spots not forming fasciae posteriorly. *Head* rather more than three-fourths as wide as the prothorax, the eyes prominent, distant from the base by nearly one-half of their length; punctures fine but deep, rather sparse, the frontal impressions wide and moderate; antennae long, almost equalling the head and prothorax, black, with the second joint scarcely paler, the tenth perceptibly longer than wide, eleventh oval. *Prothorax* scarcely one-half wider than long, widest and evenly rounded at basal third, the sides thence rather strongly convergent and nearly straight to the apex, the latter arcuato-truncate and not quite as wide as the head; disk finely but deeply, not very densely perforato-punctate, rugose in much less than lateral fourth; interspaces sparsely and feebly variolate or indented. Scutellum moderate in size, albido-pubescent. *Elytra* twice as long as wide, not evidently wider than the prothorax, parallel, rather obtusely parabolic in about apical fourth; humeri rounded, scarcely at all tumid; punctures moderate in size, rather feeble and close-set. *Legs* black, moderately long and slender. Length 3.25 mm.; width 1.1 mm.

California (San Francisco). Mr. Dunn.

The unique example is a male and has the fifth ventral flat, completely unmodified, with the usual sparse decumbent pubescence, and with the apex broadly truncate. The antennæ are unusually long, and this is probably a specific character, as I have not been able to note much variability in this organ due to sex.

11. **L. pardalis** n. sp.—Oblong-oval, convex, polished, black with a feeble æneous lustre; legs black, the antennæ black or piceous-black, with the second joint not distinctly paler, the basal joint large and deep black; pubescence moderately short, coarse, rather sparse, arranged in a complex pattern on the elytra, of which a narrow uneven fascia at apical third is particularly noticeable. *Head* fully two-thirds as wide as the prothorax, the eyes rather large but not very prominent; punctures somewhat fine and well separated, the interspaces flat and smooth toward the middle; frontal impressions broad but distinct; antennæ about one-fourth longer than the prothorax, somewhat slender, the tenth joint as long as wide and scarcely asymmetric. *Prothorax* transverse, one-half wider than long, the sides feebly convergent and straight in apical half to the broadly rounded angles, becoming parallel and feebly arcuate posteriorly; apex broadly arcuato-truncate, much wider than the pedunculiform part of the base, which is pronounced; disk strongly and closely perforato-punctate, the interspaces flat and smooth toward the middle, scabrous and opaque in distinctly less than lateral fourth. *Elytra* nearly twice as long as wide, scarcely wider than the prothorax toward base but feebly inflated in apical half, very obtusely and subcircularly rounded behind; punctures moderately large and somewhat sparse. *Legs* moderate, the hind tarsi long and slender, almost as long as the tibiæ. Length 3.25 mm.; width 1.25 mm.

California (Mountains of Sta. Cruz Co.).

The single type is a female. In this species the pattern of cinereous hairs on the elytra is better defined and with the pubescence apparently more persistent than in those which precede, and it is further remarkable in having the fringe at the sides of the prothorax composed of hairs which are longer, stiffer and darker than usual, and in the posterior inflation of the elytra.

12. **L. senilis** Lec.—Proc. Acad. Nat. Sci., Phila., VI, p. 170; l. c., 1866, p. 358.

Female rather stout and convex, the male more slender; body densely and uniformly clothed with moderately long, subdecumbent, coarse and dense cinereous hairs, the integuments black, polished, the punctures of the head and pronotum densely and polygonally crowded and rugulose though shallow, of the elytra coarse, deep and close-set; legs and antennæ black throughout, the latter slightly longer than the prothorax, with a distinct

three-jointed club, the tenth joint transverse. Prothorax two-fifths wider than long, the sides but feebly convergent from near the base to the obtuse apical angles; apex broadly arcuate. Elytra two-thirds to three-fourths longer than wide, distinctly wider than the prothorax. Length 2.5–3.2 mm.; width 0.8–1.2 mm.

Kansas, Colorado, New Mexico and Arizona. The measurements apply to the extremes of a very large series. The fifth ventral of the male is rather more than one-half longer than the fourth, truncate at apex, with the surface slightly flat and perfectly unmodified, the pubescence white, normal and decumbent throughout, except the two usual long black and erect ambulatorial setæ at each side near the apex; the genital segment is broadly, feebly bisinuate at apex, flat, with a fine median canaliculation. The dorsal pygidium projects behind as seen from below, its under surface being clothed with blacker and more erect hairs, and it is probably this which was observed by LeConte (l. c., p. 358), and not the apex of the fifth ventral.

13. **L. clavicornis** n. sp.—Elongate-oval, strongly convex, moderately shining, black with a feeble æneous-metallic lustre; pubescence moderately long, decumbent, evenly distributed and sparse. *Head* four-fifths as wide as the prothorax, the eyes prominent, surface densely and rugosely sculptured, the punctures polygonally crowded and rather shallow; antennæ black throughout, moderate in length, with a three-jointed club, the tenth joint transverse. *Prothorax* transverse, rather more than one-half wider than long, the sides feebly but distinctly convergent and only slightly arcuate from near the base to the apical angles, which are obtuse and rounded; apex wide and broadly arcuate; base broadly and feebly pedunculate; marginal fringe short and dense; disk broadly, evenly convex. *Elytra* oblong, two-thirds longer than wide, distinctly wider than the prothorax, parallel, rather acutely ogival in apical third; punctures moderately large, deep and decidedly sparse. *Legs* somewhat short, deep black throughout. Length 2.5 mm.; width 0.8–0.9 mm.

Arizona.

The description is taken from the male, the female being not larger or greatly different in form, but with a decidedly smaller head. In the male the fifth ventral is sparsely clothed with ordinary pubescence throughout, truncate at apex and unmodified. This species is allied to *senilis*, but differs in its smaller size and relatively shorter form, in its much sparser vestiture and much shorter and more transverse prothorax. Five specimens.

14. **L. uniformis** n. sp.—Elongate, parallel, convex, moderately shining, black with a dull æneous lustre; legs and antennæ piceous-black; pubes-

cence moderately long and coarse, evenly distributed and rather sparse. *Head* three-fourths as wide as the prothorax, densely punctato-rugose, the punctures shallow; anterior impressions moderate, separated at the frontal margin by a shining impunctate space; epistoma narrow, polished, impunctate, pale and subcoriaceous; labrum dark; eyes rather prominent; antennæ distinctly longer than the prothorax, somewhat slender, the fifth joint dilated as usual, club feeble, the tenth joint almost as long as wide. *Prothorax* short, strongly transverse, three-fifths wider than long, narrowly rounded and widest near the base, the sides thence strongly convergent and nearly straight to the obtuse apical angles; apex feebly arcuate, the base broadly, almost evenly and more strongly arcuate; disk broadly and evenly convex, dull and sculptured like the head. *Elytra* short, oblong, parallel, barely two-thirds longer than wide, not evidently wider than the prothorax, obtusely parabolic in apical third, the punctures strong, rather coarse and moderately close-set. *Abdomen* feebly sculptured and rather shining, the legs moderate in length. Length 2.4 mm.; width 0.9 mm.

#### Arizona.

Allied to *clavicornis*, but distinguishable at once by its slightly denser vestiture, much broader prothorax, less clavate antennæ with a decidedly less transverse tenth joint, and by the broadly impressed sulcus of the genital segment; the fifth ventral of the male is truncate at apex, with the surface broadly flattened and normally pubescent. A single male.

15. **L. obscurellus** Lec.—Proc. Acad. Nat. Sci., Phila., VI, p. 170 (Dasytes); l. c., 1866, p. 358 (Listrus).

Rather stout, suboval, convex, black throughout, the head and pronotum with finely reticulate interspaces and feeble æneous lustre, the elytra with dull but indefinitely sculptured interspaces and a feeble bluish tinge; pubescence extremely short, remote, evenly distributed and decumbent. Head three-fourths as wide as the prothorax, quite finely and sparsely punctate, the impressions feeble; epistoma short, transverse, pale and coriaceous; eyes prominent, rather small; antennæ slender, nearly one-half longer than the prothorax, the three-jointed club feeble, tenth joint one-third wider than long. Prothorax about one-third wider than long, the sides subparallel, evenly arcuate; punctures small, deep and sparse, the sculpture rugose near the sides. Elytra oval, one-half longer than wide, nearly one-half wider than the prothorax, obtusely ogival at apex, broadly sinuate at base, the humeri anteriorly and obtusely prominent; sides parallel and broadly arcuate; disk rather finely and sparsely, feebly but sub-

rugosely punctured. Legs moderate in length and decidedly slender. Length 2.1 mm.; width 0.75 mm.

California (San Diego). I have only seen the female of this species, which is one of the smallest and most isolated of the genus; it evidently belongs to the *senilis* group, however, because of the uniformly distributed pubescence and three-jointed antennal club, but differs completely in the sculpture of the head and pronotum.

16. ***L. extricatus*** n. sp.—Elongate, parallel, moderately convex, polished, black with a reddish or cupreous lustre; legs black, the tibiae and tarsi pale rufo-testaceous; antennae piceous, the basal joint black, the second testaceous; pubescence rather long, moderately coarse, close and semi-erect, cinereous, with confused denuded spots and lines on the elytra, a fine and strongly bizigzag band behind the middle and a broader and more even non-interrupted straight fascia at apical fourth being especially noticeable. *Head* two-thirds as wide as the prothorax, the eyes moderate in size, somewhat prominent and distant from the base; surface densely and deeply punctato-rugose and dull, the anterior impressions broad and feeble; epistoma with a wide coriaceous apical margin; antennae distinctly longer than the prothorax, the tenth joint but slightly wider than long. *Prothorax* transverse, fully one-half wider than long; sides strongly convergent and broadly arcuate from near the base to the broadly obtuse apical angles; apex feebly arcuate, more strongly so and narrower than the projecting base; disk deeply and densely punctato-rugose, more coarsely and densely so toward the sides. *Elytra* long and parallel, fully three-fourths longer than wide, only slightly wider than the prothorax, broadly and very obtusely rounded in apical fourth; base transversely truncate, the humeri right and narrowly rounded; punctures rather coarse, deep, moderately close-set, the interspaces convex and highly polished. *Legs* rather long, the hind tarsi slender. Length 2.8–3.0 mm.; width 1.0–1.15 mm.

California (San Diego). Mr. Dunn.

The male, serving as the type of the above description, has the fifth ventral along the median line very short, not longer than the fourth, the apex broadly but distinctly sinuate and the disk flat and entirely unmodified, the pubescence decumbent, ashy and normal; behind the fifth ventral, the horizontal under part of the dorsal pygidium is flattened, transversely oval and densely clothed with erect blackish hairs. I cannot perceive the true genital segment in any of the four specimens before me.

Two examples from Utah represent a feeble geographical variety, agreeing throughout except that the size is a trifle larger and the pronotal sculpture much smoother toward the middle.

17. **L. canescens** Mann.—Bull. Mosc., 1843, p. 247 (Dasytes); Mots.: l. c., 1859, ii, p. 391 (Listrus); Lec.: Proc. Acad., Phila., 1866, p. 357 (Listrus).

Somewhat narrow, convex, polished, black with a strong viridi-æneous lustre; legs black, the tibiæ and tarsi faintly picescent; antennæ black, the second joint piceo-testaceous; pubescence rather short and sparse, moderately coarse, denuded in large areas on the elytra of which two wide and straight transverse fasciæ on the elytra behind the middle are especially noticeable, the anterior frequently interrupted at the suture; interspaces on the head and median parts of the pronotum smooth, flat and almost sculptureless. Head nearly four-fifths as wide as the prothorax, rather sparsely and unequally punctate, the impressions very feeble; eyes moderately prominent; antennæ slender, nearly one-half longer than the prothorax, the tenth joint slightly longer than wide. Prothorax two-fifths wider than long, the sides convergent and feebly arcuate from near the base; disk rather closely and strongly punctate, rugose and opaque in lateral fourth. Elytra three-fourths longer than wide, slightly wider than the prothorax, parallel, parabolic at apex, coarsely and moderately closely punctate. Length 2.7 mm.; width 1.0 mm.

California (Marin Co.). The fifth ventral of the male is one-half longer than the fourth, flat and normally pubescent in basal half, but clothed with long dense and semi-erect black hairs and also feebly impressed toward apex, the latter broadly and distinctly sinuate; behind the sinus the pubescent under surface of dorsal pygidium is distinctly visible. Four perfectly uniform male specimens.

18. **L. difficilis** Lec.—Proc. Acad. Nat. Sci., Phila., II, p. 170 (Dasytes); l. c., 1866, p. 358 (Listrus).

Narrow, convex, black, with a greenish-metallic lustre, the pubescence nearly as in *canescens*, the denuded band just behind the middle feebly bisinuate and the subapical band frequently broken into two spots on each elytron. Head three-fourths as wide as the prothorax, the eyes prominent and at some distance from the base; surface confusedly punctato-rugose; antennæ piceous, the basal joint black, the second testaceous, outer joints cinereo-pubescent, the tenth as wide as long. Prothorax one-half wider than long, the sides strongly convergent and almost

straight from near the base; disk closely and strongly punctate, the interspaces feebly rugose but polished, opaque and strongly rugose in lateral fourth. Elytra three-fourths longer than wide, parallel and straight at the sides, slightly wider than the prothorax, rather more finely punctate than in *canescens*, the punctures moderately sparse. Length 2.5–3.0 mm.; width 0.8–1.2 mm.

California (Sta. Clara and Napa Cos.). The female is decidedly stouter than the male above outlined, with the head smaller and the elytra shorter and broader; the fifth ventral of the male is short though distinctly longer than the fourth, and is transversely truncate at apex, the surface even and unmodified; the genital segment is broadly sinuate at apex, with a narrow median canaliculation, and the dorsal pygidium is visible at apex. In the female the fifth ventral is longer, rounded, with the surface deflexed at apex and apparently somewhat impressed. This species is represented in my cabinet by a large series.

I have before me three specimens from Truckee, in the Sierras, which are almost undistinguishable from the typical forms of *difficilis*, but which have the fifth ventral of the male broadly and feebly sinuate at apex; they apparently represent a closely allied species or subspecies.

19. **L. fidelis** n. sp.—Narrow, elongate, convex, polished, with a grayish-æneous lustre; legs black, the tibiae except toward base and tarsi rufo-piceous; antennae piceous-black, the second joint piceo-testaceous, the basal joint large black and cinereo-pubescent; pubescence long, coarse and dense on the pronotum, less dense on the elytra. Head four-fifths as wide as the prothorax, the eyes rather large and prominent, the facets mutually adjacent; surface densely punctate, feebly rugose toward the sides, the anterior impressions feeble; epistoma rectilinearly truncate and black throughout; antennae rather long and slender, one-half longer than the prothorax, the fifth joint much longer and wider than the fourth or sixth, triangular, tenth distinctly longer than wide. Prothorax scarcely one-half wider than long; sides broadly rounded toward base, rather strongly convergent and becoming almost straight thence to the broadly obtuse and rounded apical angles; apex feebly arcuate, wider than the feebly pedunculiform part of the base; disk rather finely and closely perforato-punctate, becoming rugose in much less than lateral fourth. Elytra elongate, four-fifths longer than wide, slightly wider than the prothorax, subparallel, scarcely visibly dilated posteriorly, the apex evenly parabolic; punctures somewhat coarse, deep and close-set. Legs moderately stout, the hind tarsi slender and slightly shorter than the tibiae. Length 2.75 mm.; width 0.85 mm.

California.

The single male before me has the fifth ventral transversely and

evenly truncate at apex, about one-third longer than the fourth, with its surface completely unmodified and clothed with the usual decumbent ashy pubescence.

This species is allied to *difficilis*, agreeing in the general character of the sexual modifications, but differs much in its longer elytra, longer coarser denser and more confusedly denuded pubescence, less transverse prothorax and other features.

20. **L. tritus** n. sp.—Narrow, elongate and convex, the integuments black, shining and slightly brassy but densely clothed with rather long coarse and subdecumbent cinereous hairs, which are generally not at all denuded on the elytra except in a few spots behind the middle, of which four arranged transversely in the position of the usual fascia at apical fourth are particularly evident. *Head* fully three-fourths as wide as the prothorax, the neck rather strongly narrowed; eyes moderate in size but decidedly prominent; punctures moderately sparse, the interspaces coarsely rugose but polished; subapical impressions feeble; antennæ slender, nearly one-half longer than the prothorax, piceous-black, the second joint paler, tenth rather longer than wide. *Prothorax* two-fifths wider than long, parallel and evenly arcuate at the sides in basal half, thence strongly convergent and straight to the obtusely rounded apical angles, the serrulation very fine and feeble; apex feebly arcuate; disk opaque under low power; punctures moderately close, the interspaces strongly rugose but polished, more evidently and coarsely rugose as usual in rather less than lateral fourth. *Elytra* long, four-fifths longer than wide, quite distinctly wider than the prothorax, parallel and straight at the sides, narrowly parabolic in apical third or fourth; disk rather coarsely, deeply and closely punctate. Under surface finely pubescent as usual, the legs black throughout. Length 2.8–3.0 mm; width 0.9–1.1 mm.

California (Lake Co.).

The three males before me represent a close ally of *difficilis*, but can be specifically distinguished by the more elongate body clothed with longer, denser and much coarser pubescence, the latter being denuded in definite areas only behind the middle. From *fidelis* it also differs in this last character, and in its smaller eyes and more opaque and rugose sculpture of the pronotum. The fifth ventral is about one-half longer than the fourth, truncate at apex and unmodified on the disk.

21. **L. confusus** n. sp.—Elongate-oval, moderately convex, black with a feeble æneous lustre on the elytra; legs black, the tarsi slightly pale; antennæ piceous-black, the second joint paler and piceo-testaceous; pubescence rather long, suberect, moderately coarse, not very dense, consisting of cinereous hairs which, on the elytra, are brownish in certain small scattered spots with indefinite boundaries, brown toward the middle of the pronotum except along



the median line. *Head* three-fourths as wide as the prothorax, rather rugose, finely and somewhat sparsely punctate, deeply and broadly biimpressed anteriorly, the impressions but slightly separated; epistoma with a wide pale apical margin; eyes rather prominent; antennæ distinctly longer than the prothorax, somewhat stout toward apex, the tenth joint as long as wide but unusually asymmetric, being more pointed and pubescent internally at apex. *Prothorax* transverse, rather more than one-half wider than long, narrowly rounded at basal third, thence strongly convergent and straight to the obtuse apical angles, which are scarcely at all rounded from above; apex broadly, rather strongly arcuate; disk somewhat finely and densely punctate, the punctures unusually shallow and irregular, the narrow interspaces not rugose but finely, sparsely and unevenly punctate, the lustre very dull, the lateral rugose area not distinctly delimited. *Elytra* oblong, only slightly wider than the prothorax, three-fourths longer than wide, parallel and straight at the sides, parabolic at apex, with a short and narrow sutural notch; punctures rather coarse and sparse. *Legs* moderately long and stout, the hind tarsi slightly shorter than the tibiae. Length 2.7-2.75 mm.; width 0.9-1.0 mm.

California (San Francisco). Mr. Dunn.

A single pair of this species was sent to me some years ago, and the description is drawn from the male, the female being almost similar but slightly stouter, with a distinctly smaller head and less prominent eyes. The sexual characters are of the same type as in *difficilis*, from which it can be known at once by the confused pubescence and shallow opaque sculpture of the pronotum. A single female from southern California represents a species closely allied to this, which it would serve no good purpose to define at present.

22. **L. variegatus** n. sp.—Oblong-oval, moderately convex, highly polished throughout, black with a feeble violaceo-metallic lustre; legs black, the tibiae and tarsi piceo-rufous; antennæ piceo-testaceous, the basal joint black, second paler, outer joints gradually slightly blackish; pubescence moderately long, fine, sparse, dark brown and quasi-denuded in a broad median band and another more irregular near apical fourth, also in several subbasal spots. *Head* only slightly narrower than the prothorax, the eyes rather small and prominent; punctures fine and sparse, the anterior impressions broad, moderate, separated at apex by a large feebly elevated and nearly smooth area; apical margin of the epistoma not pale; antennæ slender, only very feebly incrassate, the tenth joint distinctly longer than wide. *Prothorax* barely two-fifths wider than long, widest and broadly rounded at basal two-fifths, the sides almost equally and feebly convergent and straight to base and apex, the basal angles nearly right and not rounded, the apical obtuse and slightly blunt; apex feebly arcuate; disk rather finely and sparsely perforato-punctate, the interspaces wide, flat, and almost sculptureless though very absolutely and unevenly punctulate, becoming scabrous and dull in lateral fifth.

*Elytra* oblong, barely two-thirds longer than wide, one-third wider than the prothorax, parallel and straight at the sides, very obtusely parabolic in rather less than apical third; base rectilinearly truncate, the humeri right, narrowly rounded; punctures moderately coarse, deep and decidedly sparse. *Abdomen* alutaceous, finely and feebly punctulate, reticulate and finely, moderately densely pubescent. Length 2.6 mm.; width 1.0.

California (Mendocino and Napa Cos.).

The three specimens in my cabinet are females, the fifth ventral being rounded behind and feebly deflexed, the apex of the abdomen bristling with a few very long and erect black setæ. *Variiegatus* resembles *luteipes* almost perfectly, but is larger, with a relatively narrower and less transverse prothorax, shorter vestiture and black femora.

23. **L. incertus** n. sp.—Elongate, convex, polished, black, the upper surface with a strong violaceo-metallic lustre; legs black, the tibiæ and tarsi rufo-piceous; antennæ piceous-black, the second and third joints paler; pubescence short, only moderately coarse and dense, in great part denuded on the elytra in large spots toward base and wide irregular bands at the middle and at apical fourth. *Head* slightly but distinctly narrower than the prothorax, the eyes rather large and prominent; punctures small, moderately sparse, the surface rugose laterally and toward base; anterior impressions broad; epistoma transversely impressed and thinned toward apex but not pale; labrum intense black throughout, broadly arcuate at apex; antennæ slender, almost as long as the head and prothorax in the male, with the tenth joint more than one-third longer than wide, a little shorter in the female, with the tenth joint scarcely longer than wide. *Prothorax* one-half or more wider than long, narrowly rounded and widest near the base, the sides strongly convergent and nearly straight thence to the obtuse apical angles; apex broadly and feebly arcuate; disk finely, closely punctate and generally dull, the interspaces sparsely and finely pitted, coarsely rugose toward the sides. *Elytra* three-fourths longer than wide, parallel, obtusely rounded or parabolic behind, quite distinctly wider than the prothorax, rather finely and not densely punctate. Length 2.5–2.8 mm.; width 0.75–1.0 mm.

California (Sta. Clara Co.).

This species is allied to *variegatus*, and differs in its shorter and more opaque pronotum. The general characters of the description are taken from the male, in which sex the fifth ventral is trapezoidal, broadly truncate at apex and unmodified on the disk; in the female the head is relatively slightly smaller, but the eyes are almost as prominent as in the male. Five specimens.

24. **L. annulatus** n. sp.—Stout and oblong, convex, highly polished, black with a greenish-metallic lustre; legs black, the tibiæ and tarsi rufo-

piceous; antennæ black, the funicle slightly paler toward base; pubescence rather short and sparse, moderately coarse, forming a broad even cinereous fascia at basal and apical third, and a narrower fascia enveloping the apex; intermediate dark fasciæ clothed with finer blackish hairs; anterior pale band prolonged narrowly along the suture to the scutellum. *Head* two-thirds as wide as the prothorax, finely, sparsely and unevenly punctate, rugose only toward the eyes and base; impressions distinct, short and widely separated; apical margins of the epistoma and labrum somewhat pale and subcoriaceous; eyes rather large and subprominent; antennæ very slender, the basal joint stout as usual; two-fifths longer than the prothorax, scarcely visibly incrassate, the tenth joint barely as long as wide, eleventh elongate-oval, pointed and nearly as long as the two preceding. *Prothorax* short and strongly transverse, fully two-thirds wider than long, widest and rather broadly rounded toward base, the sides strongly convergent and almost straight in apical half; serrulation rather coarse and strong; apical angles obtuse, the apex truncate; disk finely and sparsely perforato-punctate, the interspaces wide, flat, polished and sculptureless, coarsely scabrous only in lateral fifth or sixth. *Elytra* oblong, scarcely three-fifths longer than wide, distinctly wider than the prothorax, feebly dilated behind basal third, with the sides feebly arcuate, broadly ogival at apex, not very coarsely but strongly and quite sparsely punctate. Length 2.4 mm.; width 0.95 mm.

California (Truckee); Utah (Provo).

The type from the Sierras seems to be a female, and the Provo specimen is quite similar. This is one of the more distinct and isolated species of the genus, and may be readily known by the evenly banded arrangement of the vestiture.

25. ***L. rubripes*** n. sp.—Stout, oblong-oval, convex, polished, black with an æneous lustre; legs throughout bright rufous; antennæ piceous-black, the funicle distinctly paler toward base; pubescence short and sparse, not very coarse, the pale ashy hairs arranged in three transverse fasciæ on the elytra, the first extending from the base to rather beyond basal third and enclosing two subscutellar dark spots, the second narrow and near apical third, and the third enveloping the apices; dark bands and spots clothed as usual with finer dark hairs. *Head* nearly three-fourths as wide as the prothorax, finely, sparsely punctate, only feebly rugulose, the eyes moderately prominent but well developed; labrum slightly pale at apex, the epistoma black; frontal impressions distinct and widely separated; antennæ moderately stout and incrassate, with some sparse erect setæ toward tip, distinctly longer than the prothorax, the tenth joint barely as long as wide. *Prothorax* transverse, fully one-half wider than long, broadly rounded and parallel at the sides, narrowed and with the sides straight toward apex, widest near basal two-fifths; disk rather sparsely punctate, the interspaces flat and smooth, rugose in lateral fifth; punctures only moderately deep. *Elytra* oblong, two-thirds longer than wide, one-third wider than the prothorax, slightly wider at apical two-fifths than at base, the sides feebly arcuate; apex broadly and obtusely rounded;

punctures coarse and sparse. *Abdomen* shining, finely reticulate, the legs moderate in length, the anterior tibiae devoid of external spines. Length 2.5 mm.; width 1.0 mm.

Colorado.

Somewhat resembles the last, but readily distinguishable by the bright red legs and somewhat different disposition of the pubescent fasciæ. A single female.

26. **L. luteipes** Lec.—Proc. Acad. Nat. Sci., Phila., VI, p. 170 (*Dasytes.*); l. c., 1866, p. 358 (*Listrus*).

Narrow, polished, black, slightly æneous in lustre, the legs bright rufous throughout; antennæ testaceous, the first and outer joints darker; pubescence moderately long and dense and somewhat coarse, quasi-denuded in a wide median band which becomes broader and rhombiform toward the suture, in an irregularly zigzag fascia at apical fourth, and, on each elytron, in a small apical and two subscutellar spots. Head four-fifths as wide as the prothorax, the eyes rather prominent, the punctures fine and sparse; impressions distinct; antennæ almost as long as the head and prothorax, the tenth joint nearly one-half longer than wide. Prothorax scarcely more than one-third wider than long, dilated toward base, finely and sparsely punctate, the punctures very deep and perforate, rugose in lateral fifth or sixth; interspaces perfectly smooth. Elytra parallel and straight at the sides, three-fourths longer than wide, only very slightly wider than the prothorax, moderately coarsely and closely punctate. Length 2.0–2.5 mm.; width 0.75–0.9 mm

California (Los Angeles and Napa Cos.). A common and very readily recognized species in the coast regions of middle and southern California. The above outline is from the male, the sexual characters being as in *difficilis*; the female is slightly stouter, with a rather smaller head, slightly more transverse prothorax, and with the elytra feebly dilated posteriorly; there seems to be only slight sexual divergence in the antennæ, but some individuals have the basal joint also pale.

27. **L. concurrens** n. sp.—Narrowly convex, sub-parallel, black, the head and pronotum dull, the elytra polished and with a feeble æneous lustre; legs red throughout; antennæ black, the funicle piceo-testaceous toward base; pubescence rather long and sparse, the cinereous hairs of the elytra of normal slender structure, with a wide dark band at the middle and another narrower at apical fourth, the latter interrupted at the middle of each elytron; vesti-

ture toward base feebly quasi-denuded in two rounded spots on each elytron. *Head* nearly four-fifths as wide as the prothorax, flat, densely punctato-rugose, the impressions feeble and separated by a large impunctate spot; eyes rather large and only moderately prominent; antennae somewhat stout, of the usual length, the tenth joint slightly wider than long and feebly obtrapezoidal. *Prothorax* feebly transverse, but slightly more than one-third wider than long, widest and somewhat obtusely angulate at basal third, the sides thence moderately convergent and straight to the apex; disk densely punctato-rugose and opaque. *Elytra* two-thirds longer than wide, fully two-fifths wider than the prothorax, parallel and straight at the sides, the apex very broadly and obtusely ogival and narrowly deliscent as usual, the sutural angles right and not blunt; base truncate, the humeri slightly tumid and rather broadly rounded. Length 1.9 mm.; width 0.7 mm.

Nevada (Reno).

The two males, which are the sole representatives of this distinct and diminutive species, have the fifth ventral truncate at apex, the disk feebly flattened posteriorly, the white hairs there becoming slightly more erect and directed obliquely toward the median line. It resembles *luteipes* somewhat, but is still smaller and differs conspicuously in the very dense and opaque sculpture of the pronotum under low power.

28. **L. balteellus** n. sp.—Narrow, parallel, convex, the elytra polished and with a feeble æneous lustre, black, the legs red with the tibiae toward base and tarsi sometimes picescent; antennae black, the funicle paler toward base; pubescence rather sparse, that in basal half of the elytra rather long and coarse, cinereous and with only feeble traces of small brown spots, that in the even transverse fascia at apical third apparently a little shorter, denser and more decumbent, the apex with scattered pale hairs; dark bands clothed with blackish hairs. *Head* three-fourths as wide as the prothorax, finely, densely punctate, the impressions broad and feeble; eyes rather large, moderately prominent; antennae somewhat short and stout, moderately incrassate, with erect bristling setae toward tip, the tenth joint scarcely as long as wide. *Prothorax* transverse, three-fifths wider than long, the sides evenly and feebly arcuate and anteriorly convergent throughout, widest at basal third; apex arcuate, the angles extremely obtuse and indefinite; disk densely, deeply and polygonally punctato-scabrous and dull. *Elytra* two-thirds longer than wide, only very slightly wider than the prothorax, parallel and nearly straight at the sides, the apex obtusely parabolic; base transversely truncate, the humeri right and narrowly rounded; punctures moderately coarse and close-set, finer and less dense toward apex. Length 1.9–2.3 mm.; width 0.6–0.8 mm.

California (San Diego).

The description is taken from the male, the fifth ventral being truncate at apex and unmodified on the disk. The female is

much larger, with relatively broader elytra and a smaller head. The prothorax is decidedly, though broadly pedunculate at base.

Of this interesting species I took two specimens some years since; it is distinguishable at once from any other by the coloration of the legs, opaque pronotum and uneven vestiture.

29. **L. famelicus** n. sp.—Elongate, narrow, convex, black, the upper surface with a feeble subcupreous tinge, the head and pronotum opaque, the elytra feebly shining and with faintly reticulate sculpture; legs bright red, the tibiae near the base and tarsi slightly obscure; antennae black, the funicle piceo-testaceous toward base; pubescence irregular, sparse and rather fine anteriorly, the white hairs of the elytra wide, long, lanceolate and subsquamiform, unevenly and sparsely marmorate among the shorter slender blackish hairs toward base, but forming a narrow condensed transverse fascia at apical third, and also slightly evident toward apex; remainder of the surface clothed sparsely with much shorter and more slender dark hairs. *Head* four-fifths as wide as the prothorax, densely punctato-rugose, the eyes rather large and prominent; impressions subobsolete; antennae somewhat thick, moderately incrassate, distinctly longer than the prothorax, the tenth joint as long as wide, the eleventh oval and obtusely pointed as usual and nearly as long as the two preceding combined. *Prothorax* moderately transverse, one-half wider than long, widest and somewhat narrowly rounded near basal third, the sides thence rather strongly convergent and nearly straight to the obtuse but somewhat evident apical angles; apex very broadly arcuato-truncate, the base broadly arcuate and scarcely pedunculate; disk very densely punctato-rugose. *Scutellum* quadrate, densely albido-pubescent. *Elytra* three-fourths longer than wide, only very slightly wider than the prothorax, the apex rather acutely parabolic; humeri blunt and right; disk strongly, evenly but moderately coarsely and closely punctate. *Legs* somewhat short and stout. Length 1.8 mm.; width 0.65 mm.

California (Los Angeles Co.). Mr. H. C. Fall.

The single male before me is the type of an interesting and isolated species, distinguishable from any other by the coarse and scale-like lanceolate white hairs which are distributed very unevenly on the elytra; the white hairs in the preceding species are of the usual structure. The fifth ventral of the male is truncate at apex but otherwise unmodified. *Famelicus* is the smallest species of the genus discovered thus far.

30. **L. ornatulus** n. sp.—Oblong-suboval, moderately convex, polished, black with a scarcely perceptible æneous lustre; legs black, the tarsi scarcely picescent; antennae black, the second joint not distinctly paler; pubescence moderately long, dense and coarse, of normal structure, the denuded areas

clothed with finer blackish hairs; elytra with a narrow denuded band at the base, a broad cinereous fascia extended thence to apical two-fifths which encloses a complex pattern of denuded spots and lines, then a broad rhombiform denuded fascia at apical fourth, the apex being again cinereo-pubescent. *Head* two-thirds as wide as the prothorax, finely, rather sparsely punctate and rugose, the wide interspaces almost smooth toward the center of the disk; impressions feeble, separated at apex by a smooth impunctate spot; eyes moderately large, not very prominent; antennæ moderate, the tenth joint equilatero-triangular and almost symmetrical. *Prothorax* three-fifths wider than long, widest and rather narrowly rounded near the base, the sides strongly convergent and nearly straight thence to the apex; disk very densely punctate, rugose and dull under low power. *Elytra* but slightly more than one-half longer than wide, nearly one-half wider than the prothorax, parallel near the base, distinctly inflated and with the sides parallel and arcuate in apical three-fourths; apex very broadly and obtusely ogival; disk rather finely but strongly, not very closely punctate. Length 2.0-2.25; width 0.8-1.0 mm.

Nevada (Reno).

The description relates to the female, and the male is, as usual, smaller and narrower, parallel, not inflated behind, with a larger head and more prominent eyes, and the prothorax only about two-fifths wider than long; in addition, the basal denuded band of the female elytra is less evident. The fifth ventral of the male is broadly sinuato-truncate at apex but otherwise unmodified.

I took a good series of this species, which is not unusually variable, although the tibiae and tarsi of some specimens become pale and reddish.

**DASYTELLUS** n. gen.

The species of this genus are the smallest members of the tribe Dasytini thus far discovered in North America. They are allied to Dasytes, as here accepted, in general organization, especially in having an impressed submarginal pronotal line delimiting a lateral area of greater rugosity, and in the very narrow epipleuræ which gradually become subvertical and evanescent behind, but differ in having the unguis appendages well developed and generally fully as long as the claws. The anterior tibiae are slender, clothed rather densely with short and decumbent ashy hairs, and are completely devoid of spinules. The antennæ as a rule are much shorter and more incrassate toward tip than in Dasytes, and the marginal cilia of the body are very short and lie close to the surface, being usually altogether invisible under low power.

No species with erect hairs interspersed amid the ordinary decumbent pubescence are known at present.

The species are probably numerous, but only eight are here characterized as follows :—

Body slender and generally less conspicuously pubescent.

Testaceous, the elytra black.....1. **concinus**

Black or piceous-black throughout above.

Legs pale rufo-ferruginous throughout.....2. **prætenis**

Legs black or piceous.

Pubescence very fine, sparse, dark cinereous and inconspicuous; body very slender.

Pubescence less short and sufficiently obvious.....3. **exilis**

Pubescence exceedingly short and indistinct....4. **inconspicuus**

Pubescence pale, distinct and rather dense; body less slender.

The vestiture fine.....5. **nigricornis**

The vestiture coarse; smaller species.....6. **degener**

Body oval or oblong-oval, densely clothed with very coarse decumbent pubescence; legs dark.

Vestiture uniform and cinereous-white.....7. **elegantulus**

Vestiture cinereous, variegated on the elytra with small uneven areas of brownish .....8. **subovalis**

This genus is distributed widely over the arid regions of the southwest, and does not appear to occur at all in the true Pacific coast fauna, where it is replaced by the larger and more diversified species of *Dasytes*.

1. **D. concinus** n. sp.—Slender, convex, rather shining, pale rufo-testaceous, the apex of the pronotum and base of the head slightly infusate; elytra and abdomen black; antennæ black, pale at base, the legs pale throughout; pubescence closely decumbent, pale luteo-cinereous, rather long and somewhat coarse, not very dense. *Head* fully three-fourths as wide as the prothorax, finely reticulate, almost invisibly and sparsely punctulate, the frontal impressions small, apical and feeble; epistoma rather long, truncate; labrum wider than long, circularly rounded; eyes large but not at all prominent, attaining the base; antennæ slender, much longer than the prothorax, distinctly incrassate toward tip, the joints scarcely asymmetric, the penultimate strongly transverse. *Prothorax* one-fourth wider than long, the sides broadly and feebly rounded, a little straighter and more convergent toward apex, the lateral edges becoming almost obsolete; apex quite distinctly narrower than the base, arcuato-truncate, the base feebly arcuate; angles obtuse; disk finely, sparsely punctate, more strongly near the sides. *Elytra* long, two-thirds longer than wide, two-fifths wider than the prothorax and more than three times as long, feebly dilated and with the sides slightly arcuate behind basal third; apex obtusely subogival; punctures fine but rather strong



and somewhat close-set. *Abdomen* very finely and sparsely clothed with plumbeo-cinereous pubescence. Length 1.5 mm.; width 0.55 mm.

Utah (southwestern). Mr. Weidt.

The type and only specimen known to me is a female, the fifth ventral being rather long, strongly rounded behind, with the disk feebly impressed in the middle near the tip. The epipleuræ are very narrow, subvertical, and become wholly obsolete long before the apex, as usual in this and allied genera.

2. **D. prætennis** n. sp.—Narrow, rather convex, strongly shining, black with a scarcely visible bluish lustre; legs pale; antennæ pale testaceous, blackish toward apex; pubescence rather fine, sparse, decumbent, cinereous, distinct but not conspicuous and without trace of erect hairs or bristling fimbriæ. *Head* fully four-fifths as wide as the prothorax, flat, feebly reticulate, the punctures not distinct; frontal impressions small, feeble and widely separated; epistoma rather long, pale; labrum pale, long, strongly rounded; eyes moderately large, convex and prominent; antennæ much longer than the prothorax, slender, distinctly incrassate toward tip, the penultimate joints strongly transverse and rather compactly joined. *Prothorax* two-fifths wider than long, the sides just visibly convergent, evenly and moderately arcuate from base to apex, the angles all obtuse and somewhat rounded though evident; apex feebly arcuato-truncate, very slightly narrower than the base which is only a little more arcuate; disk obsoletely reticulate, finely and sparsely punctate, rugose at the sides, the sublateral impressed line distinct. *Elytra* two-thirds longer than wide, two-fifths wider than the prothorax, parallel, the sides feebly arcuate except toward base; apex evenly rounded; disk finely but very distinctly punctate, the punctures rather close-set and feebly asperulate, the interspaces smooth and polished. Under surface very sparsely and inconspicuously pubescent. Length 1.5 mm.; width 0.5 mm.

Arizona. Mr. Wickham.

My single representative of this species is a female, the fifth ventral being evenly but broadly rounded behind and apparently very slightly impressed on the disk at apex; the genital segment is smooth, broadly and evenly arcuate at apex, with the disk transversely impressed and not in the least canaliculate along the middle. The ungual appendages are well developed and fully as long as the claws, to which they are attached nearly throughout. This and the preceding are the smallest dasytide forms known to me.

3. **D. exilis** n. sp.—Narrow, rather convex, polished, black; femora black, the tibiæ and tarsi piceo-rufous; antennæ piceo-rufous, black toward tip; pubescence fine, rather short, sparse, closely decumbent, even, dark cinereous, not at all conspicuous but distinct, the marginal cilia not evident; erect setæ

completely wanting. *Head* three-fourths as wide as the prothorax, slightly convex, wider than long, feebly and coarsely reticulate, the punctures exceedingly minute and sparse; impressions nearly obsolete; epistoma very short; labrum small, strongly rounded; eyes rather small, moderately prominent; antennæ short, slightly longer than the prothorax, incrassate toward tip, the last three joints especially wider, penultimate transverse, fifth very feebly dilated. *Prothorax* three-fifths wider than long, the sides strongly rounded toward base, strongly convergent and nearly straight toward apex, the basal angles very obtuse but not completely obliterated, the apical blunt; apex much narrower than the base, the latter broadly arcuate; disk feebly reticulate, finely and sparsely punctate, more coarsely but not strongly reticulato-rugose toward the sides, the impressed submarginal line distinct toward base. *Elytra* three-fifths longer than wide, two-fifths wider than the prothorax, convex, parallel, feebly dilated and with the sides slightly arcuate except toward base; apex rather strongly rounded; sutural angles obtuse, the apical edge finely serrulate and just visibly subexplanate; punctures fine but strong and not dense, the interspaces polished. *Abdomen* sparsely but distinctly cinereo-pubescent. Length 1.5–1.75 mm.; width 0.6–0.75 mm.

#### Arizona.

The description is drawn from the female, that sex having the fifth ventral much longer than the fourth. triangular, with the apex narrowly subtruncate; the male is more slender, with the head four-fifths as wide as the prothorax, the sides of the latter parallel and broadly arcuate, and the fifth ventral broadly trapezoidal and feebly flattened toward the apex, which is broadly arcuato-truncate. Numerous specimens.

4. **D. inconspicuus** n. sp.—Narrow, subcuneiform, moderately convex, polished, black, the elytra just perceptibly picescent; femora black, the tibiæ and tarsi piceo-rufous; antennæ black, the funicle slightly piceous toward base, the second joint pale; pubescence very short, sparse, closely decumbent, dark brownish-cinereous in color and scarcely obvious under low power; erect setæ wanting, the marginal cilia scarcely at all visible. *Head* three-fourths as wide as the prothorax, wider than long, feebly convex, rather strongly but coarsely reticulate, the punctures not distinct; frontal impressions subobsolete; epistoma moderate in length, the labrum strongly rounded; eyes rather small, slightly prominent; antennæ short though distinctly longer than the prothorax, feebly and evenly incrassate toward tip, the penultimate joints transverse. *Prothorax* two-thirds wider than long, the sides somewhat strongly rounded toward base, convergent and straight or very feebly sinuate toward apex; apex and base equally and feebly arcuato-truncate, the former slightly the narrower; apical angles obtuse but distinct, the basal very broadly obtuse and obliterated; disk feebly reticulate, finely and sparsely punctate, the submarginal impressed line distinct toward base, the surface thence to the lateral edges a little more reticulato-rugose. *Elytra* barely three-fifths longer than wide, one-

half wider than the prothorax, gradually wider with the sides nearly straight to apical third, almost semi-circularly rounded behind; punctures fine but strong, even and moderately close-set. *Abdomen* very sparsely and inconspicuously clothed with plumbeo-cinereous hairs. Length 1.5–1.7 mm.; width 0.6–0.7 mm.

Southern California. Mr. H. C. Fall.

This species is evidently rather closely related to the last, but it differs in vestiture, in its more posteriorly broadened form, in its longer epistoma, and in the less narrowly truncate subtriangular fifth ventral of the female. The description is drawn from that sex for facility of comparison, but the male differs scarcely at all, having the elytra very slightly shorter and the apex of the fifth ventral broadly arcuato-truncate. In both of these species the ungual appendage is fully developed and as long as the claws. Four specimens.

5. **D. nigricornis** Bland—Proc. Ent. Soc. Phila., 1864, p. 254 (*Pristoscelis*); Lec.: Proc. Acad. Nat. Sci., Phila., 1866, p. 358 (*Dolichosoma*).

Narrow, strongly convex, subparallel, strongly shining though feebly reticulate throughout, densely so on the head, black, the legs piceous-black; antennæ black throughout; pubescence moderate in length, cinereous, sparse, moderately fine and distinct, decumbent and without trace of erect setæ. Head rather more than three-fourths as wide as the prothorax, much wider than long, very minutely, sparsely punctate, the epistoma short and with a polished black margin; labrum dark, transverse, strongly rounded; eyes small and not very prominent; antennæ short though one-third longer than the prothorax, strongly incrassate toward tip, the penultimate joints transverse. Prothorax two-thirds wider than long, the sides broadly arcuate, more convergent and straighter toward apex; angles all obtuse; apex and base feebly arcuato-truncate, the former scarcely perceptibly narrower; disk finely and sparsely punctate, the submarginal impressed line distinct particularly toward base, the sculpture slightly rugose near the sides. Elytra three-fifths longer than wide, scarcely two-fifths wider than the prothorax, the sides parallel and scarcely arcuate, becoming oblique and feeble arcuate toward apex, the latter very narrow and obtuse; disk finely but strongly, rather closely punctate. Length 1.75–1.9 mm.; width 0.8–0.85 mm.

Kansas, Nebraska and Texas (Austin). The female described

above has the fifth ventral evenly and strongly arcuate at apex. The single specimen from Austin, which I regard as the male, has the elytra relatively shorter and broader, with the fifth ventral somewhat narrowly truncate at tip.

It is singular that Dr. LeConte should have failed to observe the strong affinity of this species with those which he placed in *Dasytes*; there is absolutely no single point of resemblance with *Dolichosoma foveicollis*, with which it was associated by that author.

6. **D. degener** n. sp.—Elongate, suboval, convex, polished, black, the elytra more or less paler and piceous; femora piceous-black, the trochanters, tips of the femora, tibiae and tarsi piceo-rufous; antennae dark piceous, slightly paler toward tip; pubescence coarse, cinereous, decumbent and distinct but sparse. *Head* three-fourths as wide as the prothorax, transverse, feebly convex, strongly reticulate and obsoletely punctulate, the frontal impressions feeble and widely separated; epistoma short, the labrum small, transverse and strongly rounded, the mandibles and labrum somewhat pale in color; eyes small but rather prominent; antennae short and slender, distinctly longer than the prothorax, the outer joints wider, the penultimate transverse. *Prothorax* three-fourths wider than long, the sides strongly rounded at the base, thence convergent and nearly straight to the apex, the latter narrower than the base which is broadly arcuate; angles obtuse and blunt; disk finely and sparsely punctate, feebly reticulato-rugose near the sides, the submarginal line normal. *Elytra* rather short, not quite three-fifths longer than wide, scarcely two-fifths wider than the prothorax, the sides parallel; apex somewhat obtusely ogival; punctures fine but strong, moderately close, the interspaces polished. Under surface deep black and sparsely pubescent throughout. Length 1.5 mm.; width 0.75 mm.

Arizona (Benson). Mr. Dunn.

The type above described seems to be a female, the male having the sides of the prothorax broadly arcuate throughout and nearly parallel, with the fifth ventral broadly and feebly arcuato-truncate at tip. There is some variability displayed in the six specimens before me, the upper surface being deep black throughout in some, and, in one example, the prothorax becomes twice as wide as long and almost fully as wide as the elytra; but I believe that this specimen may possibly represent a closely allied though distinct specific form. The specimens are all in rather poor condition.

7. **D. elegantulus** n. sp.—Stout, suboval, strongly convex, moderately shining, black, the legs and antennae black throughout; pubescence moderately long, closely decumbent, coarse, cinereous-white, dense, even and very con-

spicuous, without trace of erect hairs. *Head* two-thirds as wide as the prothorax, strongly reticulate, smooth near the apex, obsoletely punctulate; epistoma short, the labrum small and transverse, strongly rounded, piceous-black; mandibles stout, pale testaceous throughout except at the tip; eyes small and rather prominent; antennæ short, slender, much longer than the prothorax, gradually and sensibly incrassate toward tip, the penultimate joints transverse, fifth not noticeably dilated. *Prothorax* three-fifths wider than long, the sides strongly rounded at the base, thence distinctly convergent, gradually becoming almost straight to the apex, which is arcuato-truncate and narrower than the base, the latter broadly arcuate; angles obtuse; disk obsoletely reticulate, more strongly rugulose toward the sides, minutely and sparsely punctate, the submarginal line distinct. *Elytra* one-half longer than wide, three-fifths wider than the prothorax, the sides parallel and feebly arcuate; apex subparabolic; disk finely but strongly, densely punctate. Under surface distinctly but only moderately densely cinereo-pubescent, the legs slender. Length 1.65–1.8 mm.; width 0.75–0.85 mm.

Arizona (near the Cañon of the Colorado).

The female is described above and this sex has the sides of the fifth ventral convergent, the apex being narrowly arcuato-truncate. The male is larger than the female and has the prothorax less transverse, with the sides arcuate and only slightly convergent, the apex of the fifth ventral only a little more broadly truncate than in the female. Five specimens recently taken by Dr. T. Mitchell Prudden.

8. **D. subovalis** n. sp.—Stout, oblong, suboval, convex, black, the legs slightly piceous; antennæ black; pubescence coarse, dense, closely decumbent and very conspicuous, cinereous-white, with small, widely and unevenly dispersed spots in which the hairs become dark brown in color though otherwise not different; erect hairs wanting. *Head* rather more than two-thirds as wide as the prothorax, transverse, reticulate, scarcely visibly punctate, the impressions obsolete; epistoma short, the labrum short and strongly rounded, both rufo-piceous; mandibles pale; eyes small and rather prominent, basal; antennæ short, slender, distinctly incrassate toward tip, very much longer than the prothorax, the penultimate joints transverse. *Prothorax* short and broad, five-sixths wider than long, the sides rounded at the base, convergent and straighter thence to the apex, the latter much narrower than the base, both feebly arcuate; angles obtuse; punctures very small, sparse, the surface more rugose laterally with the submarginal line distinct. *Elytra* short, scarcely one-half longer than wide, not quite one-third wider than the prothorax, the sides parallel, feebly arcuate except near the base; apex not very broadly and almost circularly rounded; disk finely and moderately closely punctate. Under surface shining, thinly and not very conspicuously cinereo-pubescent. Length 1.45–1.55 mm.; width 0.6–0.7 mm.

Arizona; Texas.

The sex of the type is not clearly determinable, but the two specimens from Arizona are mutually similar and are more probably male than female. The single example from Texas seems to belong to the species, although the elytra are relatively larger and more elongate, and the size distinctly larger; it is not included in the measures.

### **DASYTES** Fabr.

This name, as applied to the American representatives, will include those species of the tribe Dasytini which have the anterior tibiæ slender and devoid of spinules, the unguar appendages equal but very short or rudimentary, and the pronotum with a roughly sculptured and abruptly limited marginal area. The epipleuræ are even less developed than in *Trichochrous*, being moderately wide with their plane inclined upward at base, rapidly assuming the form of a mere fine line very near the elytral margin on the vertical flanks and disappearing completely far in front of the apex. The head is much shorter, the eyes smaller and the antennæ longer and more filiform than in that genus, and the frontal impressions are generally feeble or obsolete. The erect hairs interspersed among the ordinary pubescence are present in some species and altogether absent in others, proving still further that this character is not of generic value in *Trichochrous*.

The species are somewhat numerous and those known to me may be outlined as follows:—

Submarginal line of the pronotum strong, impressed and entire; body generally more cuneiform.....2

Submarginal line feeble, frequently only evident as an abrupt division between the smooth and rugose portions of the surface.

Elytra without longitudinal vittæ.....3

Elytra each with several dark vittiform lines.....4

2—Pubescence distinctly intermingled with longer erect black hairs.

Elytral vestiture blackish throughout; thoracic sculpture rather dense.

#### **1. hudsonicus**

Elytral vestiture cinereous throughout, except the longer erect hairs which are black; thoracic punctures sparse.....2. **obtusus**

Elytral vestiture cinereous but becoming dark and inconspicuous behind the middle; elytra broad and depressed.....3. **expansus**

Pubescence not intermingled with longer erect hairs.

Legs black throughout; elytral vestiture blackish and inconspicuous.

#### **4. nitens**

Legs bicolored, the femora black.

Elytral pubescence blackish and inconspicuous but becoming ashy toward base.....5. **breviusculus**

Elytral pubescence pale cinereous throughout, even but rather sparse; body more elongate.....6. **dissimilis**

**3**—Elytral vestiture uniform in distribution, cinereous and distinct but not very dense or coarse.

Legs black or blackish in color.

Larger species, the head smaller; elytral vestiture consisting of shorter and longer hairs which are confusedly intermingled..7. **fastidiosus**

Smaller and narrower, the head almost as wide as the prothorax; vestiture even and less dense.....8. **macer**

Legs bicolored, pale rufous, the femora black.

Prothorax moderately transverse; elytra with very short and sparse erect hairs, intermingled throughout with the more decumbent pubescence.....9. **cruralis**

Prothorax twice as wide as long, the erect hairs of the elytra extremely short and indistinct, only visible toward apex.....10. **depressulus**

Legs pale rufo-ferruginous throughout, the posterior femora occasionally slightly darker.

Prothorax much narrower than the base of the elytra.....11. **pusillus**

Prothorax equal in width to the base of the elytra.....12. **minutus**

Elytral vestiture uneven in distribution, the pale hairs forming a broad median and apical fascia.....13. **seminudus**

**4**—Body stout, convex, very densely clothed with coarse and decumbent pale pubescence, without trace of erect setæ.....14. **lineellus**

The American species of *Dasytes* inhabit the true Pacific coast faunal regions almost exclusively, the few forms known from the Rocky Mountains having probably descended from the north, in conformity with well known laws of distribution.

1. **D. hudsonicus** Lec.—Proc. Acad. Nat. Sci., Phila., 1866, p. 360.

Stout, oblong, moderately convex, shining, deep black throughout, the legs and antennæ not at all paler; pubescence of the pronotum short, sparse, subcinereous and intermixed with considerably longer stiff erect black hairs, of the elytra black, suberect and moderately dense throughout, with a large proportion of the hairs a little longer and more erect, especially toward the sides. Head transverse, three-fourths as wide as the prothorax, feebly rugulose, finely but strongly and somewhat closely punctate, the front broadly impressed; eyes moderate; antennæ slender, filiform, about as long as the head and prothorax, the penultimate joints fully as long as wide, the eleventh elliptical and nearly twice as long as wide. Prothorax twice as wide as long, widest

just behind the middle, where the sides are rather strongly rounded, thence feebly convergent and nearly straight to the basal angles, which are obtuse but not rounded, and strongly convergent and distinctly sinuate to the apical angles, which are obtuse but only slightly blunt; apex arcuato-truncate, much narrower than the base, which is broadly and rather feebly arcuate; disk minutely and feebly rugulose, very coarsely and deeply reto-rugose near the sides, finely and somewhat closely punctate; side margins slightly serrulate. Elytra large, three-fifths longer than wide, about one-third wider than the prothorax, slightly wider at apical third than at base and with the sides slightly arcuate; apex obtusely parabolic; punctures fine, subrugose and rather close-set, the interspaces shining. Abdomen minutely and densely punctulate, sparsely luteo-pubescent. Length 3.7 mm.; width 1.5 mm.

Hudson Bay Territory, Colorado and Arizona. The description is drawn from a male taken in the alpine regions of Colorado, and the two similar specimens before me from "Arizona," probably inhabited the high mountain lands if the labels are correct. The allusion to cinereous hairs in the description of LeConte is erroneous as far as the elytra are concerned.

The ungual appendages are thick and subglobular, unusually developed for this genus, but seem to be attached in rather less than basal half of the claws.

2. **D. obtusus** n. sp.—Oblong, stout, rather strongly convex, polished, black; femora black, the tibiae and tarsi in great part dark piceo-rufous; antennae piceous, gradually testaceous toward base, the first joint again a little darker; pubescence short, sparse, cinereous, intermixed throughout with rather numerous and moderately long erect black hairs, which bristle irregularly also along the side margins. *Head* strongly transverse, fully three-fourths as wide as the prothorax, feebly and very remotely biimpressed at apex, finely but strongly punctate, densely so toward the sides, the interspaces smooth and polished; epistoma short, truncate, pale and coriaceous; labrum deflexed, large, transverse and truncate; eyes moderate in size, rather prominent; antennae long and slender, filiform, nearly as long as the head and prothorax, the joints slightly elongate, the eleventh elongate and gradually pointed. *Prothorax* four-fifths wider than long, the sides evenly and strongly arcuate throughout, slightly more convergent toward apex; all the angles obtuse and slightly blunt; apex a little narrower than the base, both feebly arcuato-truncate; edges finely serrulate; disk smooth and polished, finely and sparsely punctate, becoming abruptly coarsely and deeply reto-rugose near the sides. *Elytra* short, scarcely two-fifths longer than wide, one-third wider than the prothorax, feebly arcuate at the sides and scarcely visibly wider behind the



middle than at base, the apex very obtusely parabolic, the edge not at all serrulate; disk finely, sparsely and but slightly rugosely punctate, the interspaces smooth and polished. Under surface clothed sparsely with short cinereous hairs. Length 3.0 mm.; width 1.4 mm.

Colorado.

The male serving as the type has the fifth ventral short and very broadly sinuato-truncate, the genital segment short, flat, apparently not at all canaliculate along the middle and feebly sinuato-truncate at tip; the dorsal pygidium has the lower edge thin and not dilated into a flat plate as in *Trichochrous*. The unguinal appendages are short and basal.

3. **D. expansus** n. sp.—Stout, subcuneiform and depressed, polished, black, with a feeble coppery lustre anteriorly; legs black, the tarsi picescent, the apex of the femora and base of the tibiae slightly rufescent; antennae black throughout; pubescence rather short and sparse, semi-erect, cinereous but becoming blackish behind the middle of the elytra, mingled with short erect and blackish setae especially toward the sides of the body. *Head* fully three-fourths as wide as the prothorax, slightly transverse, strongly and closely punctate, the punctures slightly elongate, the interspaces smooth and polished; front feebly and remotely biimpressed, the frontal margin broadly smooth and slightly convex; epistoma rather long, the labrum not deflexed, broadly arcuato-truncate at apex; eyes rather prominent; antennae slender and filiform, the penultimate joints fully as long as wide. *Prothorax* widest at basal two-fifths where the sides are broadly rounded, thence becoming convergent and just visibly arcuate to apex and base, the former arcuato-truncate and slightly narrower than the base, which is more arcuate; basal angles obtuse but not rounded and minutely prominent; apical angles obtuse and blunt; edges finely subserrulate; disk smooth and polished, strongly convex, finely but strongly and rather closely punctate, strongly rugose near the sides. *Elytra* short, scarcely more than one-third longer than wide, at apical third much wider than at base and nearly one-half wider than the prothorax; sides arcuate, the apex obtuse and broadly rounded, the sutural angles rounded; disk nearly flat, rather coarsely and closely punctate, the interspaces strongly shining. Under surface very feebly convex and sparsely pubescent. Length 2.6 mm.; width 1.3 mm.

California (north of San Francisco).

The unique type is apparently a female, but the species may be readily known by its depressed, cuneate form and by the characteristics of vestiture detailed in the description. It differs from *breviusculus* in its dense pronotal punctures and in the coloration of the antennae and legs.

4. **D. nitens** n. sp.—Subcuneiform, strongly convex, polished, deep black with a faint greenish-metallic lustre; legs and antennae deep black

throughout, pubescence rather long and sparse, even, suberect, blackish and not conspicuous, slightly cinereous toward the base of the elytra externally; marginal cilia very short but fimbriiform, black. *Head* very short and strongly transverse, three-fourths as wide as the prothorax, finely and sparsely punctate and feebly subrugose, the apical margin slightly tumid transversely; epistoma short, with a thin, smooth margin, the labrum strongly transverse and broadly rounded; eyes rather small and convex, basal; antennæ long, slender, filiform, longer than the head and prothorax, the joints slightly elongate, the eleventh very strongly so and gradually pointed. *Prothorax* three-fourths wider than long, the sides parallel and broadly arcuate, becoming convergent and straight or feebly sinuate in about apical half, minutely sinuate just before the basal angles which are distinct; apical angles obtuse; apex and base feebly and equally arcuate, the former much the narrower; edges feebly serrulate; disk polished, finely and remotely punctulate, the submarginal line distinct throughout and feebly sigmoid, the surface coarsely and deeply reto-rugose at the sides. *Elytra* three-fifths longer than wide, one-half wider than the prothorax, feebly dilated behind with the sides arcuate; apex semi-circular; disk rather finely but strongly, sparsely and subrugosely punctate, the interspaces polished. *Abdomen* thinly clothed with fine plumbeo-cinereous pubescence. Length 2.2–3.2 mm.; width 0.9–1.35 mm.

California (Marin and Sonoma Cos.).

The female is described above, the fifth ventral being subconical with the apex subtruncate. The male is smaller and narrower, parallel, with the fifth ventral more broadly arcuato-truncate and the antennæ still longer and also thicker. This species is allied to *breviusculus*, but differs in its larger size, coloration of the legs and antennæ and in the more elongate elytra. Many specimens.

5. **D. brevisculus** Motsch.—Bull. Mosc., 1859, ii, p. 396.

Stout, convex, cuneiform, polished, black with a very feeble subæneous lustre anteriorly; femora black, the trochanters, tibiae and tarsi red; antennæ black, the funicle pale at base, the first joint blackish; pubescence short, fine and sparse, blackish in color and inconspicuous, becoming pale luteo-cinereous on the head, near the basal angles of the prothorax, and toward the base and at the apex of the elytra; erect hairs wholly wanting. Head four-fifths as wide as the prothorax, obsoletely reticulate, finely and sparsely punctate, the impressions widely separated and almost obsolete; mandibles pale; antennæ rather longer than the head and prothorax, slender and filiform, the penultimate joints fully as long as wide. Prothorax two-thirds wider than long; the sides rounded at basal third, thence distinctly convergent

and nearly straight toward apex and base, the former arcuato-truncate and narrower than the more arcuate base; basal angles obtuse but distinct and not rounded, the apical obtuse and rounded; lateral edges finely serrulate; disk polished and convex, minutely and remotely punctate, coarsely reto-rugose near the sides. Elytra two-fifths longer than wide, at posterior third much wider than at base and one-half wider than the prothorax with the sides arcuate; apex semi-circular; disk convex, finely and sparsely punctate, the punctures becoming feeble toward apex. Length 2.3 mm.; width 1.1 mm.

California. The single specimen, which I took in the coast region north of San Francisco, is a female, and the fifth ventral is broadly rounded and feebly impressed in the middle at the apical margin; the genital segment is large, slightly deflexed, broadly angulate at apex and is feebly impressed at the middle of the disk. There can be scarcely any doubt at all that this is the species of Motschulsky, as it agrees with his description in every essential feature; the species identified by LeConte under the name *breviusculus*, is however quite a different thing, which I am unable to place in the absence of the type, but which may possibly be the *nitens* described above.

6. **D. dissimilis** n. sp.—Elongate, convex, polished, black with a feeble greenish-æneous lustre; legs rufous, the femora black except at apex; antennæ blackish, the second and some of the following joints less distinctly, pale; pubescence suberect, moderately long, cinereous, rather sparse and even, a few hairs toward the elytral sides and apex slightly longer than the others but not more erect. *Head* very nearly as wide as the prothorax, smooth and burnished, minutely and remotely punctulate, the frontal impressions widely separated, apical and pronounced; epistoma short, the labrum broadly rounded; mandibles black; eyes prominent; antennæ slender, filiform distinctly longer than the head and prothorax, all the joints longer than wide, the eleventh about as long as the two preceding. *Prothorax* fully one-half wider than long; sides rounded behind the middle, thence feebly convergent and somewhat sinuate to the apex, feebly convergent and nearly straight to the base, the basal angles obtuse but distinct, the apical but slightly obtuse; apex and base subequal; disk very obsoletely reticulate, polished, minutely and remotely punctate, coarsely reto-rugose near the sides. *Elytra* fully three-fifths longer than wide, but very slightly wider near apical third than at base and about one-half wider than the prothorax; sides feebly arcuate posteriorly, the apex broadly parabolic, finely but distantly serrulate, the sutural angles not distinctly rounded; disk rather coarsely; subrugosely and sparsely punctate, the interspaces polished. Under surface very sparsely pubescent. Length 2.5 mm.; width 1.0 mm.

Southern California. Mr. H. C. Fall.

The female described above has the fifth ventral rounded behind, the apex subtruncate in the middle, the genital segment being perfectly flat and even and strongly, evenly rounded at the apex. In general form and vestiture this species more nearly resembles *macer*, of the next group, than any member of the *breviusculus* section of the genus, but differs in its coarser and sparser elytral punctures and bicolored legs.

7. **D. fastidiosus** n. sp.—Elongate and subparallel, rather depressed, shining, black with a feeble æneous lustre; legs blackish, the anterior and intermediate tibiae slightly rufescent especially toward base; antennae black; pubescence rather long, suberect, cinereous, moderately dense, intermingled with stiff sparse erect black setae anteriorly, which become pale, abundant and scarcely distinguishable from the ordinary pubescence on the elytra. *Head* about two-thirds as wide as the prothorax, transverse, polished, the punctures strong, rather close and slightly unequal in size; frontal impressions very feeble; epistoma rather long, the labrum broadly rounded; eyes prominent; antennae subfiliform, not quite as long as the prothorax, the penultimate joints slightly wider than long. *Prothorax* fully two-thirds wider than long, the sides rounded, a little more convergent anteriorly, feebly serrulate; basal angles obtuse but not rounded, minutely prominent and slightly reflexed; disk polished, finely but strongly, rather closely punctured, broadly rugose near the sides. *Elytra* a little more than one-half longer than wide, one-third wider than the prothorax, the sides feebly arcuate and just visibly dilated behind; apex broadly and evenly rounded; disk finely but strongly and rather densely punctured. *Abdomen* minutely and closely punctulate, sparsely pubescent. Length 2.9 mm.; width 1.15 mm.

California.

This species is distinct in having the scattered erect setae quite well developed anteriorly but subobsolete on the elytra; it is described from a female from an unrecorded part of the State, and is apparently unique.

8. **D. macer** n. sp.—Parallel, rather narrow, moderately convex, polished, black, the legs and antennae black throughout; pubescence cinereous, moderately dense and somewhat short, not very coarse, suberect and intermixed toward the sides with a few erect black setae on the pronotum, subdecumbent, even and without erect hairs on the elytra. *Head* but slightly wider than long, only a little narrower than the prothorax, polished and smooth throughout, minutely and sparsely punctate, the impressions very feeble; epistoma and labrum moderately elongate, the latter arcuato-truncate at apex; eyes rather small and prominent; antennae long and thick but filiform and loose, nearly two-fifths as long as the body and much longer than the head and prothorax, the joints rounded. *Prothorax* nearly three-fifths wider than long,

the sides minutely serrulate, feebly convergent and very slightly arcuate from the broadly rounded and apparently obliterated basal angles to the apex, the apical angles but slightly obtuse; apex quite distinctly narrower than the base, both feebly arcuate; disk smooth, minutely and remotely punctate, abruptly rugose near the sides. *Elytra* parallel, three-fifths longer than wide, not quite one-third wider than the prothorax, the sides nearly straight; apex evenly but obtusely rounded; disk finely but strongly and closely punctate, the interspaces shining. Under surface finely and sparsely pubescent. Length 2.25 mm.; width 0.8 mm.

Southern California.

The fifth ventral segment in the unique male type is broadly arcuato-truncate at apex, and the genital segment has a broad median impression and the apex broadly rounded.

9. ***D. cruralis*** Lec.—Proc. Acad. Nat. Sci., Phila., 1866, p. 355 (*Pristoscelis*).

Oblong, parallel, feebly convex, polished, black; legs red with the femora black; antennæ black throughout; pubescence short, rather dense, cinereous, intermixed anteriorly with sparse erect blackish hairs, and, on the elytra, with extremely short erect cinereous setæ. Head four-fifths as wide as the prothorax, flat, smooth, strongly and closely punctate, the impressions subobsolete; frontal margin broadly tumid and impunctate; epistoma very short and broad, the labrum moderate, broadly rounded at apex; eyes small and prominent; antennæ long, filiform, as long as the head and prothorax, the joints rounded, the tenth slightly wider than long, the eleventh longer than the two preceding and a little wider, gradually pointed in apical two-thirds. Prothorax three-fifths wider than long, the sides subparallel and rather strongly, evenly rounded throughout, the edges minutely serrulate; basal angles broadly rounded and obsolete; apex just visibly narrower than the base, both very feebly arcuate; disk finely but strongly, rather closely punctate, abruptly and coarsely reto-rugose at the sides, the line of demarcation not impressed. *Elytra* one-half longer than wide, less than one-third wider than the prothorax, parallel and nearly straight at the sides, evenly rounded in apical third, the punctures fine but somewhat strong and close-set. Length 2.2–2.4 mm.; width 0.85–1.05 mm.

California and Oregon. This species is common in the coast regions of northern California, and the specimen described above is a male, with the apex of the fifth ventral broadly truncate and

apparently very broadly and feebly bisinuate. The head in the female is relatively but little smaller, but the prothorax is somewhat more narrowed toward apex and the elytra just perceptibly and gradually wider behind. The unguual appendages are very short and rudimentary, and the anterior tibiae completely devoid of spinules. I have before me a large series agreeing in every respect with the original type of LeConte.

10. **D. depressulus** n. sp.—Ovoidal, feebly convex, shining, black; legs rufo-ferruginous, the hind thighs, except at tip, black, the anterior and intermediate piceous-black; antennae black throughout; labrum, mandibles and apex of the epistoma pale piceo-rufous; pubescence cinereous, rather short, moderately dense, intermingled with a few erect black setae anteriorly and with more numerous, very short and scarcely distinct erect pale hairs on the elytra. *Head* rather small, three-fifths as wide as the prothorax, strongly and closely punctate and slightly rugose, the impressions nearly obsolete; labrum feebly arcuate at apex; eyes moderately small, convex; antennae long, filiform, the joints rounded. *Prothorax* twice as wide as long, the sides parallel, distinctly and almost evenly arcuate, the edges feebly and finely crenulate; basal angles obtuse but not rounded, the apical feebly obtuse and not very blunt; apex and base subequal, feebly and almost equally arcuate; disk finely and somewhat closely punctate, rugose in a wide and feebly delimited lateral area. *Elytra* one-half longer than wide, quite distinctly wider at apical two-fifths than at base and about two-fifths wider than the prothorax; apex almost semi-circular; disk finely, evenly and rather closely punctured. Under surface finely and somewhat sparsely luteo-pubescent. Length 2.6 mm.; width 1.25 mm.

Nevada.

A moderately large species, readily recognizable by the sub-depressed form, small head, very transverse prothorax and coloration of the legs. It is represented in my cabinet by a single female type.

11. **D. pusillus** Lec.—Proc. Acad. Nat. Sci., Phila., VI, p. 170; l. c., 1866, p. 360.

Suboval, rather narrow and convex, the head and pronotum smooth and polished, the elytra very obsoletely reticulate; body piceous-black, the legs rufo-ferruginous; antennae blackish-piceous, scarcely paler toward base; pubescence moderately long, coarse and dense, closely decumbent, fulvo-cinereous in color and without trace of intermixed erect hairs. Head three-fourths as wide as the prothorax, minutely and sparsely punctate; antennae only moderate in length though subequal to the head and pro-

thorax, slender and filiform, the penultimate joints slightly wider than long. Prothorax three-fourths wider than long, the sides distinctly convergent and broadly, almost evenly arcuate from base to apex, the edges finely serrulate; basal angles broadly rounded and apparently obsolete, the apical obtuse; apex subtruncate, much narrower than the base which is distinctly arcuate; disk minutely and sparsely punctate, moderately scabrous rather narrowly along the sides, the rugose area abrupt but not limited by an impressed line. Elytra one-half longer than wide, near apical third slightly wider than at base and about three-fifths wider than the prothorax, the sides nearly straight; apex obtusely parabolic and very indistinctly and minutely serrulate; punctures fine, feebly rugose and somewhat close-set. Length 2.0 mm.; width 0.85 mm.

California (San Diego). The description is drawn from a specimen which has the apex of the fifth ventral broadly truncate and therefore most probably male, but the antennæ are shorter, the head smaller and the sides of the prothorax more convergent than usual in the corresponding sex of allied species.

12. **D. minutus** n. sp.—Narrow, subcylindrical, rather strongly convex, the anterior parts smooth and highly polished, the elytra very obsoletely subreticulate but polished; body piceous-black, the elytra and abdomen slightly paler; legs pale testaceous; antennæ black, the first joint piceous the second flavo-testaceous; palpi black, the mandibles very pale, blackish at the acute apex; pubescence short, cinereous-white, moderately dense, not at all intermixed with erect hairs. *Head* three-fourths as wide as the prothorax, slightly transverse, minutely and not very closely punctate, the punctures slightly burred toward base; impressions widely separated and feeble; epistoma abruptly thinned and depressed at apex, short and black, the labrum small, broadly rounded; eyes small; antennæ rather short, slender, not as long as the head and prothorax, the penultimate joint apparently somewhat transverse. *Prothorax* large, fully three-fourths wider than long, the sides strongly convergent and feebly, almost evenly arcuate from the broadly rounded and obsolete basal angles to the apex, the latter feebly arcuate, much narrower than the base, which is strongly and evenly arcuate throughout; disk finely, sparsely punctate, coarsely rugose in an unusually narrow marginal area, which is abrupt though feebly delimited. *Elytra* one-half longer than wide, subequal in width to the prothorax, just visibly wider near apical third, the apex obtuse; disk finely, feebly and not very closely punctate. *Abdomen* finely pubescent, the legs slender; ungual appendages about one-half as long as the claws. Length 1.6 mm.; width 0.65 mm.

California.

The single type before me is undoubtedly a male, and the fifth ventral is broadly truncate at apex. This distinct species recalls some of the small anobiides in general outline; it probably inhabits the southern parts of the State.

13. **D. seminudus** Lec.—Proc. Acad. Nat. Sci., Phila., 1866, p. 360.

Oblong, rather stout, feebly convex, the integuments smooth and highly polished, black, the legs rufo-ferruginous; antennæ blackish, pale toward base, the first joint darker; pubescence rather short, even, moderately dense, without trace of intermingled erect hairs, cinereous on the elytra at the basal margin and thence posteriorly along the suture to the broad submedian fascia, the apex also cinereous. Head rather small, transverse, two-thirds as wide as the prothorax, finely and moderately closely punctate, the eyes prominent; epistoma abruptly depressed along the apex, the labrum very transverse; mandibles in great part pale; antennæ long and slender. Prothorax nearly three-fourths wider than long, the sides subparallel, strongly and almost evenly arcuate; basal angles very obtuse but not obliterated; marginal fringe dense, even and distinct; disk finely and somewhat closely punctate, a wide lateral area rugose and abruptly delimited but without an impressed line. Elytra short, scarcely one-half longer than wide, barely one-third wider than the prothorax, subparallel and straight at the sides, the apex broadly rounded; disk finely and rather sparsely punctate, more strongly so toward base. Length 2.7 mm.; width 1.15 mm.

California. The example above described has the fifth ventral broadly truncate at apex. The legs in this specimen are pale, but in the types of LeConte they are said to be "nigro-piceis." The transverse and clearly limited bands of pale pubescence on the elytra render this one of the most distinct species of the genus.

14. **D. lineellus** n. sp.—Rather stout, strongly convex, oblong-oval, black, the legs black; antennæ and palpi black, the former slightly piceous toward base excepting the first joint; pubescence pale luteo-cinereous, coarse, rather long, extremely dense and closely decumbent, without trace of erect hairs, the elytra each with four fine longitudinal dark lines of blackish pubescence, the lines somewhat irregular, the second from the suture approaching the humeri toward base and broadly united with the fourth before the apex, the third short and lying midway between them. Head nearly three-fourths as wide as the prothorax, rather strongly and closely punctate, the epistoma rather long with a short pale coriaceous margin; labrum broadly arcuato-trun-



cate at tip; eyes small and prominent; antennæ rather short, not as long as the head and prothorax, slender, feebly incrassate toward tip, the penultimate joints slightly wider than long. *Prothorax* scarcely more than one-half wider than long, the sides convergent anteriorly and feebly arcuate throughout, broadly rounded into the base, the basal angles obsolete; apex narrower than the base, the two subequally and distinctly arcuate; lateral edge finely serrulate and with a short dense and distinct fringe; disk rather strongly and closely punctate, broadly and abruptly reto-rugose laterally, the rugose area more sparsely pubescent, not delimited by an impressed line. *Elytra* not quite one-half longer than wide, barely one-third wider than the prothorax, subparallel and nearly straight at the sides, the apex obtusely rounded; disk finely and rather closely punctate. Under surface and legs densely clothed with short even cinereous pubescence. Length 2.2-2.4 mm.; width 0.85-1.0 mm.

California (Los Angeles Co.).

The type has the fifth ventral segment short, broadly trapezoidal and rather broadly truncate at tip. The tibiæ and tarsi appear to be very slightly picescent occasionally. This is a very remarkable species in the nature and disposition of the vestiture, but seems to be wholly congeneric in structural characters. Three specimens.

#### **DASYTASTES** n. gen.

I have applied this name to certain small species resembling *Dasytes* quite closely in general organization, but differing invariably and radically in having the entire disk of the pronotum simply punctate and devoid of all trace of the abruptly defined marginal rugose area, which constitutes so constant and characteristic a feature in *Dasytes* as limited above. In addition to this it may be stated that the antennæ are shorter as a rule than in *Dasytes*, and are more definitely incrassate toward apex.

The six species known to me may be thus defined in brief:—

Body uniformly black or piceous-black in color.

Elytral vestiture cinereous throughout.

The pubescence short.

Head small; sides of the prothorax broadly subexplanate; legs feebly bicolored.....1. **catalinæ**

Head large; sides of the pronotum evenly convex and declivous; legs pale rufo-ferruginous throughout.....2. **remissus**

The pubescence long, fulvo-cinereous; legs bicolored.....3. **otiosus**

Elytral vestiture dark and inconspicuous, becoming paler and coarser toward base and at the apex.....4. **dispar**

Body bicolored, the head and prothorax pale and rufous.

Head pale throughout; elytral vestiture short, even, dense and pale cinereous over the entire surface.....5. **ruficollis**

Head blackish toward base; elytral vestiture longer, sparse and dark in color, becoming cinereous near the apex and toward the humeri.

6. **bicolor**

In geographical range these species occupy the same regions as *Dasytes*, but at present none is known to extend far to the eastward of the Sierra Nevada Mountains.

1. **D. catalinae** Lec.—Proc. Acad. Nat. Sci., Phila., 1866, p. 361 (*Dasytes*).

Elongate, suboval, rather convex, polished, black; legs rufous, the femora piceous; antennae black, piceous toward base; pubescence rather sparse and somewhat short, cinereous, decumbent and completely devoid of erect hairs. Head about three-fifths as wide as the prothorax, smooth, finely and sparsely punctate, more closely so and slightly rugose toward the sides and base; epistoma very short, the labrum arcuato-truncate at apex; eyes small and convex; antennae rather short, slender, the penultimate joints apparently slightly transverse. Prothorax nearly four-fifths wider than long, the sides parallel and distinctly arcuate, rather more strongly so behind the middle, the edge distinctly serrulate; basal angles broadly rounded, the apical obtuse but not rounded from above; apex and base equal, the former truncate, the latter broadly arcuate; disk finely, sparsely punctate, more closely so but not rugose toward the sides, where the surface becomes broadly subexplanate; marginal fringe very short but dense. Elytra two-fifths longer than wide, scarcely more than one-fourth wider than the prothorax, very slightly wider near apical third than at base, the apex somewhat obliquely narrowed, then narrowly obtuse and rounded; disk finely, not very densely punctate, strongly so toward base. Length 1.6 mm.; width 0.75 mm.

California (Sta. Catalina Island). The broadly subexplanate sides of the pronotum, small head and color of the legs will render the identification of this small but distinct species always easy when the locality is known, as it is undoubtedly confined to the island. The specimen described above has the fifth ventral broadly truncate at apex and is apparently a male.

2. **D. remissus** n. sp.—Elongate, strongly convex, moderately shining, black with a piceous tinge, the legs pale ferruginous; antennae piceous, piceo-

testaceous toward base; pubescence luteo-cinereous, moderately long and coarse, not very dense and closely decumbent, not intermixed with erect hairs. *Head* large, only slightly narrower than the prothorax, broadly convex, finely and not very closely punctate, the impressions obsolete; epistoma short, with a thin coriaceous extension, the labrum short, transverse, feebly arcuato-truncate at apex; eyes small, basal, convex and prominent; antennæ slender and filiform, rather longer than the head and prothorax, the penultimate joints fully as long as wide. *Prothorax* two-thirds wider than long, the sides subparallel, broadly and rather strongly arcuate, somewhat more obviously so toward base, the edges feebly serrulate; basal angles very broadly obtuse; apex and base feebly arcuate and subequal; disk evenly and strongly convex from side to side, finely but strongly and rather closely punctate, the marginal fringe rather long, dense and conspicuous. *Elytra* one-half longer than wide, one-fourth wider than the prothorax, the sides subparallel and nearly straight, obliquely convergent behind, the tip narrow, subtransversely truncate and strongly serrulate, not at all dehiscent at apex, the sutural angles right and not rounded; disk rather finely but strongly punctate, the punctures somewhat close-set. Under surface thinly clothed with rather long and luteo-cinereous pubescence. Length 1.9 mm.; width 0.75 mm.

California (north of San Francisco).

Of this interesting form I have before me three specimens from as many distinct localities; of these only one satisfies the above description, this example having the fifth ventral broadly truncate and being without doubt the male. The other two specimens have darker legs, the femora in one being blackish, and a broadly and evenly rounded elytral apex; the head in one of these two specimens is smaller than in the other and both have the fifth ventral more or less evenly and broadly truncate at tip. It is probable that there is some specific difference which cannot be advantageously defined at present.

3. **D. otiosus** n. sp.—Elongate, rather strongly convex, subparallel, strongly shining, the integuments very obsoletely and minutely rugulose; legs ferruginous, the femora blackish; antennæ piceous-black, testaceous toward base, the first joint blackish; pubescence long, subdecumbent, rather coarse, somewhat sparse, pale fulvo-cinereous in color, without erect hairs. *Head* transverse, three-fourths as wide as the prothorax, finely and sparsely punctate, the impressions obsolete; epistoma rather long and narrow, truncate, the labrum short and subtruncate; eyes small and convex; antennæ rather short, nearly one-half longer than the prothorax, very feebly and gradually incrassate, the penultimate joints slightly wider than long. *Prothorax* three-fifths wider than long, the sides very feebly convergent, evenly and rather feebly arcuate from base to apex, the edges scarcely serrulate; basal angles very obtuse but not obliterated; apex truncate, slightly narrower than the base, the latter broadly arcuate; disk finely, sparsely punctate, more closely

so toward the sides, evenly convex. *Elytra* rather more than one-half longer than wide, nearly one-half wider than the prothorax, scarcely visibly wider behind than at base, the sides subparallel; apex obtuse; disk somewhat coarsely and closely punctate and feebly rugose, the sculpture feebler toward apex. Under surface shining, feebly pubescent. Length 2.25 mm.; width 0.9 mm.

California.

The type and only specimen known to me has the fifth ventral rather short, trapezoidal and truncate, and the genital segment strongly and evenly rounded behind, with the disk perfectly even. I am, however, not certain of the sex of this individual, for the fifth ventral seems to be truncate in both male and female in this section of the genus.

4. **D. dispar** n. sp.—Somewhat short, strongly convex and suboval, strongly shining, the integuments feebly reticulato-rugulose, black, the legs ferruginous with the thighs darker; antennæ black, piceo-testaceous toward base; pubescence rather short and sparse, cinereous toward base and near the apex of the elytra and on the head and pronotum, finer and blackish elsewhere, devoid of erect hairs. *Head* rather more than three-fourths as wide as the prothorax, moderately transverse, feebly uneven, finely and sparsely punctate, with the frontal impressions obsolete; epistoma very short and transverse, the labrum small, transverse, truncate; eyes small but prominent; antennæ slender, not quite as long as the head and prothorax, very feebly and gradually incrassate, the tenth joint a little wider than long, the fifth very slightly dilated. *Prothorax* fully three-fourths wider than long, the sides subparallel and distinctly arcuate, rather more evidently so toward base, the edges distinctly serrulate; basal angles very obtuse but not obliterated, the apical obtuse but distinct from above, rounded as usual when viewed sublaterally; apex slightly narrower than the base, both feebly arcuate; disk finely but strongly, sparsely punctate throughout, the flanks evenly convex and declivous, strongly and narrowly impressed along the lateral edges at the basal angles; marginal fringe short but distinct. *Elytra* very feebly dilated posteriorly, not quite one-half longer than wide, nearly one-half wider than the prothorax, obtusely rounded behind; disk somewhat finely and quite sparsely punctured. *Abdomen* thinly clothed with short fine and dusky-cinereous hairs. Length 1.75–2.0 mm.; width 0.75–0.85 mm.

California (north of San Francisco).

This species is quite isolated, and is represented in my cabinet by four specimens taken in three localities; these agree very well among themselves, except that in one small example the pale fulvo-cinereous hairs of the elytra spread almost evenly over the entire surface, but under more power the pale hairs near the middle of the elytra are readily seen to be mingled with the more

slender blackish hairs of the same length. I am unable to observe any sexual differences.

5. **D. ruficollis** Ulke—Geog. and Geol. Exp. and Surv., 4 to., Wheeler, V, 1875, p. 812 (*Dasytes*).

Stout, oval and strongly convex, polished, piceous, the head, prothorax, and apex and flanks of the elytra pale flavo-testaceous; legs very pale throughout; antennæ blackish-piceous, pale testaceous in about basal half; pubescence short, even, pale cinereous, moderately dense and distinct, without trace of erect hairs. Head very short and transverse, three-fourths as wide as the prothorax, somewhat finely but strongly and rather closely punctate, the impressions obsolete; frontal margin transversely and feebly tumid and impunctate; epistoma very short and transverse, the labrum very transverse, truncate; eyes small, convex, not quite attaining the base; antennæ slender, as long as the head and prothorax, filiform, the tenth joint fully as long as wide. Prothorax three-fifths wider than long, the sides broadly arcuate toward base, gradually somewhat convergent and very feebly arcuate thence to the apex, which is arcuato-truncate and much narrower than the base, the latter feebly arcuate, the basal angles very obtuse and scarcely distinct; disk evenly convex, finely but strongly, rather closely and evenly punctate throughout, the lateral edges fine and feebly serrulate, the fringe rather short but dense and distinct. Elytra short, scarcely more than one-third longer than wide, nearly one-half wider than the prothorax, the sides subparallel and nearly straight, becoming rounded and convergent in apical two-fifths, the apex obtuse; punctures fine but strong and distinct and well separated. Legs very slender. Length 2.0 mm.; width 0.85 mm.

Nevada. A distinct form, somewhat resembling a small halticid at first glance. The specimen described above has the fifth ventral truncate and is probably a male; it seems also to be slightly immature.

6. **D. bicolor** n. sp.—Oblong, suboval, rather narrow and convex, highly polished throughout, pale rufo-testaceous, the elytra and under surface of the hind body black; head blackish toward base, the antennæ black at apex, gradually testaceous toward base; palpi and legs pale throughout; pubescence moderate in length, sparse, fulvo-cinereous, blackish on the elytra except toward base near the sides and at apex. Head transverse, two-thirds as wide as the prothorax, finely and sparsely punctate, the frontal impressions at the apical

margin very small, feeble and remotely separated; epistoma with a wide thin apical margin; labrum subtruncate; eyes very small, not extending to the base, prominent; antennæ rather short, not as long as the head and prothorax, the three outer joints distinctly wider, the penultimate slightly wider than long. *Prothorax* four-fifths wider than long, the sides strongly and evenly rounded toward base, becoming strongly convergent and almost straight in about apical half, the edge distinctly serrulate; basal angles very obtuse but traceable; apex truncate, equal to the base, the latter only feebly arcuate; disk smooth, minutely and sparsely punctate, becoming gradually obsoletely reticulate near the sides. *Elytra* very feebly dilated behind and there about one-fourth wider than the prothorax, at base equal in width to the disk of the latter, not quite one-half longer than wide, the apex evenly and not broadly rounded; disk somewhat coarsely and strongly but not densely, somewhat unevenly punctate. Under surface slightly pubescent, the hind femora somewhat piceous in color. Length 1.75–1.9 mm.; width 0.75–0.9 mm.

California (Los Angeles Co.).

The fifth ventral of the individual described is trapezoidal and rather broadly truncate at apex. This species differs greatly from *ruficollis* in its minute sparse punctuation of the anterior parts, form of the prothorax, pubescence and numerous other features. The two specimens in my cabinet are mutually similar throughout.

#### **ESCHATOCREPIS** Lec.

In this genus the ungual appendages are equal, rather slender, well developed and as long as the claws, but are clearly detached from them except near the base; in other respects *Eschatocrepis* is allied to *Listromimus*, but differs in the form of the epipleuræ, which are narrow and horizontal, with the plane gradually turned upward and inward posteriorly. The anterior tibiæ are cylindrical and devoid of all trace of spinules along the external side, and the eyes are large and basal, the antennæ rather short and either gradually incrassate or with an abrupt three-jointed club; they are scarcely at all serrate. The pronotum has a deep impressed submarginal line in both sexes.

1. ***E. constrictus*** Lec.—Proc. Acad. Nat. Sci., Phila., VI, p. 170 (*Dasytes*); Class. Col. N. A., 1861, p. 193 (*Eschatocrepis*); *constricticollis* Motsch.: Bull. Mosc., 1859, ii, p. 390 (*Listrus*).

Elongate, feebly shining, black, the legs pale rufo-ferruginous, frequently with the femora picescent; antennæ piceous, testaceous toward base; pubescence short, more or less cinereous, without trace of erect hairs. Head but slightly narrower than the pro-

thorax, the frontal impressions rather small and feeble; eyes prominent; antennae but slightly longer than the prothorax, slender, the fifth joint noticeably dilated. Prothorax not quite as long as wide, the sides parallel and broadly rounded, deeply constricted behind the apical angles which are laterally prominent; basal angles obtuse but not rounded, not at all prominent. Elytra quite distinctly wider than the prothorax, twice as long as wide in the male, relatively shorter and more dilated behind in the female. Length 2.2–3.4 mm.; width 0.7–1.15 mm.

Coast regions of California from Humboldt to San Diego. This abundant species seems to be resolvable into two or three closely allied forms, but it would scarcely be worth while to undertake the definition of them without very full series from carefully recorded localities. One form from San Diego is certainly distinct in its much more feeble thoracic constriction, denser pubescence and acute elytral apices; another from Sta. Barbara is more elongate in the body and more densely pubescent than the typical forms, in which the elytral pubescence is relatively sparse, dark and inconspicuous.

In the male the fifth ventral has a transverse and rectangular apical emargination, with the adjacent surface slightly declivous, and I can perceive little or no variation in this sexual character in the various allied forms alluded to above.

#### **ALLONYX** Lee.

The parallel form of the body and structure of the epipleurae will readily distinguish the representatives of this genus from the allied forms with similar asymmetric ungual appendages. The epipleurae are wide, flat and subhorizontal throughout, preserving their width almost unaltered to within a short distance of the apex and there terminating somewhat abruptly; their surface is finely punctured and pubescent, and the side margins of the elytra are correspondingly reflexed. The antennae are rather short, feebly incrassate and are scarcely at all serrate, the eyes large and basal, the anterior tibiae devoid of spinules, the maxillary palpi somewhat stout and pale in color, and the vestiture very feebly developed. The prothorax is not at all constricted near the apex, and the pronotum has at each side a strong excavated line parallel to and at some distance from the lateral edge, the intermediate surface being broadly subexplanate but only a little more strongly sculptured than the median parts of the disk.

The material in my cabinet seems to indicate the three following species :—

Submarginal line of the pronotum entire, extending to the apex.

Sides of the prothorax sinuate near the basal angles, which are right and somewhat prominent.....1. **sculptilis**

Sides almost evenly and feebly arcuate, not more than straight near the basal angles, which are obtuse and not at all prominent...2. **denudatus**

Submarginal line abruptly abbreviated at apical fourth or fifth of the length; basal lobe of the prothorax more gradually formed and less pronounced.

3. **disjunctus**

*Allonyx* seems to be limited in its range to the coast regions of middle California from Sta. Barbara to Mendocino, being perhaps still more circumscribed than *Eschatoctepis*. Many California trees are well known to be similarly limited in range, such as *Sequoia* and *Pinus insignis*.

1. **A. sculptilis** Lec.—Proc. Acad. Nat. Sci., Phila., 1859, p. 75 (*Dasytes*); Class. Col. N. A., 1861 and Proc. Acad., 1866, p. 359 (*Allonyx*).

Oblong, subparallel, moderately convex, rather dull and alutaceous in lustre, black with a feeble greenish tinge, the elytral apices rufescent apparently in great part from diaphaneity; legs rufo-ferruginous, the hind femora on the upper edge near the tip and the corresponding tibiae infuscate; antennae pale testaceous, the first and eleventh joints in part darker; mouth parts and labrum pale, the palpi dark at tip. Head three-fifths as wide as the prothorax, with two large impressions coalescent behind the transversely convex separating surface, the occiput thence finely striate along the middle to the base; eyes rather large, convex and basal; antennae somewhat stout but filiform, not incrassate, one-third longer than the prothorax, the fifth joint long and distinctly wider. Prothorax transverse, parallel, the sides feebly bisinuate, the disk minutely, sparsely and not very distinctly punctate, the submarginal lines entire, extending to the apex. Elytra three-fifths longer than wide, one-fourth wider than the prothorax, feebly dilated and with the sides somewhat arcuate behind, the apex broadly rounded; lateral edges somewhat reflexo-explanate; punctures fine, rather sparse and very indistinct. Abdomen black throughout. Length 3.3 mm.; width 1.35 mm.

California. The single specimen before me is a female, said by Mr. Dunn to have been taken by him in the vicinity of San Francisco; it is a female, as proved by the extruded genitalia, but the



fifth ventral is flattened and rectilinearly and broadly truncate at apex, the genital segment being broadly bilobed and deeply impresso-caniculate along the middle.

2. **A. denudatus** n. sp.—Oblong-elongate and parallel, feebly convex, rather dull and alutaceous, black, the elytral apex slightly rufescent from diaphaneity; apex of the abdomen except the base of the fifth segment bright testaceous; posterior legs black throughout except the base of the femur and the trochanters which are red, the tarsus rufo-piceous; middle legs corresponding in color except that the basal third of the femur is red; anterior legs pale rufo-testaceous throughout; antennæ pale testaceous; pubescence very short, fine, decumbent and sparse, rather dark in color on the elytra and inconspicuous. *Head* three-fourths as wide as the prothorax, dull but smooth, very obsoletely and sparsely punctulate, the impressions large and strong; epistoma very wide, with a polished and rather pale border, the labrum very transverse; eyes somewhat large and prominent; antennæ somewhat stout, one-half longer than the prothorax, the last three joints larger, the tenth about as long as wide, not much narrowed at base, fifth distinctly dilated. *Prothorax* three-fifths wider than its median length, the sides parallel, feebly and almost evenly arcuate, straight toward the basal angles, which are obtuse but not rounded and not in the least prominent; apical angles right and slightly blunt, apex almost rectilinearly truncate throughout the width, the base with a very abrupt and broad arcuate median lobe; disk finely and feebly granulato-reticulate, smooth and alutaceous, slightly rougher between the submarginal line and the side margin, the latter feebly reflexed as usual; punctures toward the middle extremely minute and sparse but abrupt and distinct under sufficient power. *Elytra* three-fifths longer than wide, one-fifth wider than the prothorax, parallel and feebly, evenly arcuate at the sides, the apex broadly rounded and subtruncate, the lateral edges reflexed and the apices subexplanate; sutural angles right, not rounded; disk confusedly though feebly and subtransversely rugose, the punctuation fine and very indistinct. Under surface finely but distinctly cinereo-pubescent, the legs well developed. Length 3.3–4.0 mm.; width 1.25–1.5 mm.

California (north of San Francisco).

The three examples before me are males, the apex of the fifth ventral being transverse and abruptly and deeply sinuate at the middle, the genital segment being deeply bilobed. In the female the legs are doubtless paler. This species differs from *sculptilis* in having the sides of the prothorax very feebly and almost evenly arcuate and not sinuate toward the basal angles, which are obtuse; the apical angles are occasionally feebly prominent anteriorly.

3. **A. disjunctus** n. sp.—Oblong, subparallel, feebly convex, dull, the elytra shining, the integuments strongly granulato-reticulate, much more obsoletely on the elytra; body black throughout, the apices of the elytra pale;

legs pale, the tip of the hind femora but slightly darker above; antennæ testaceous, the eleventh joint slightly darker; pubescence cinereous, extremely short, fine, decumbent and sparse, without trace of erect hairs. *Head* two-thirds as wide as the prothorax, more shining, the sculpture feebler, finely, feebly punctulate, the impressions large and deep, not coalescent behind, the epistoma short; labrum transverse and very broadly rounded; eyes large, prominent and basal; antennæ one-fourth longer than the prothorax, very feebly incrassate toward apex, the tenth joint evenly triangular, nearly as long as wide, fifth sensibly dilated. *Prothorax* barely three-fifths wider than long, the sides parallel, evenly and feebly arcuate, becoming slightly sinuate toward the basal angles, which are right and not rounded; apical angles slightly acute, advanced and not blunt; apex broadly emarginate; base with a very broad and feeble arcuate lobe; disk finely and sparsely but distinctly punctate. *Elytra* two-thirds longer than wide, one-fourth wider than the prothorax, very feebly and gradually dilated behind, the apex evenly rounded; lateral edges reflexed; sutural angles acute and posteriorly prominent; disk strongly and rather closely punctate, less distinctly so toward apex. *Abdomen* polished, somewhat sparsely clothed with short and fine cinereous pubescence. Length 3.5 mm.; width 1.45 mm.

#### California.

The type of this species is a female, differing from the female of *sculptilis* in having the submarginal impressed line of the pronotum abruptly ending at about apical fifth of the length. The fifth ventral is truncate as in *sculptilis*.

### VECTURA n. gen.

In this genus the body is cuneiform, with the head small and more elongate than usual, the antennæ being moderate in length, scarcely serrate and feebly incrassate at apex, the eyes situated before the base of the head and slightly elongate, and the prothorax more or less constricted near the apex, with the basal angles acute and prominent. It resembles *Allonyx* to some extent in the form of the epipleuræ, these being rather wide, flat, subhorizontal and pubescent, but, unlike those of *Allonyx*, becoming gradually narrow behind the middle. The inner claw has a very long and rather thick corneous expansion and the membranous appendage is correspondingly shortened but extends to the tip of the claw. The tibiæ are devoid of spinules as usual in this group. The two species known to me may be distinguished as follows:—

Pubescence not entirely concealing the integuments; prothorax strongly constricted behind the apical angles, which are very acute and prominent laterally.....1. **longiceps**

Pubescence extremely dense, completely concealing the integuments; prothorax very broadly and obsoletely constricted near the apex, the angles laterally obtuse, rounded and scarcely at all prominent.....2. **albicans**

In geographical range *Vectura* is probably limited to the great arid and elevated internal basin region, between the Sierra Nevada and Rocky mountains.

1. **V. longiceps** n. sp.—Broad and strongly dilated behind, cuneiform, moderately convex, feebly shining, pale ochreo-testaceous throughout, the metasternum, maxillary palpi and antennæ toward tip blackish; pubescence closely appressed, dense, yellowish-white, the hairs broad and squamiform, without trace of erect hairs; marginal fringe composed of short dense and posteriorly inclined white hairs. *Head* small, elongate, three-fifths as wide as the prothorax, flat, with indistinct sparse punctules, the impressions very feeble; epistoma transverse but well developed, the labrum large, broadly arcuate at tip; eyes elongate-elliptical, feebly convex and not attaining the base; antennæ but feebly serrate, one-fourth longer than the prothorax, the fifth and seventh joints much larger than the sixth or eighth, last three joints larger, the penultimate slightly transverse. *Prothorax* one-fourth wider than long, the sides feebly convergent from the base, feebly arcuate, slightly and broadly sinuate near the base, deeply constricted behind the apical angles which are laterally acute and very prominent; basal angles slightly acute, everted and prominent; apex arcuate, narrower than the base, which is broadly and arcuately lobed; lateral edges finely serrulate; disk finely, feebly and rather closely but indistinctly punctate, the submarginal excavated line extending only to apical fourth. *Elytra* three-fifths longer than wide, oval, gradually wider to apical two-fifths, where they are more than twice as wide as the prothorax; sides evenly and feebly arcuate; apex acutely ogival, the sutural angles minutely acute and posteriorly prominent; lateral edges narrowly reflexed; humeri exposed and transversely rounded; disk finely but strongly, distinctly and closely punctured, the interspaces shining. Under surface densely clothed with appressed white pubescence, the legs very slender and moderately long. Length 3.6 mm.; width 1.55 mm.

Arizona (Yuma). Mr. Dunn.

The typical specimen described above is a female, having the fifth ventral rounded behind, with the disk feebly impressed in the middle at the apex. I have before me two females not mutually differing at all in structure.

2. **V. albicans** n. sp.—Stout, moderately dilated posteriorly, strongly convex, the surface completely concealed by a dense even coat of rather long and closely appressed, stout and subsquamiform white hairs, without trace of intermixed setæ except the usual few erect black hairs near the abdominal apex; marginal fringe composed of short, dense and decumbent white hairs; body black, the elytra and legs pale testaceous throughout; antennæ testaceous, blackish toward tip. *Head* scarcely two-thirds as wide as the prothorax, a

little longer than wide, not greatly prolonged before the eyes, the latter however small, prominent, slightly elongate and at a considerable distance from the base, the neck subparallel behind them; surface flat, the integument completely concealed, the frontal impressions apical and feeble; labrum and apex of the epistoma pale testaceous, the palpi black; antennæ scarcely a third longer than the prothorax, the outer joints larger, the penultimate slightly transverse, the sixth and eighth small. *Prothorax* one-fourth wider than long, the sides rounded and feebly prominent behind the middle, thence strongly convergent and broadly sinuate to the apical angles which are laterally obtuse, and feebly convergent and straight to the basal angles which are acute and slightly prominent; apex arcuate, much narrower than the base which is broadly and arcuately lobed; disk convex, completely concealed by the vestiture except the excavated submarginal line, which does not attain the apex or base. *Elytra* large, two-thirds longer than wide, gradually wider posteriorly, and, at apical third, twice as wide as the prothorax; apex acutely ogival, the sutural angles slightly obtuse; humeri exposed at base; lateral edges narrowly reflexed. Under surface clothed with an extremely dense crust of white decumbent pubescence, the legs rather short but slender. Length 3.25 mm.; width 1.5 mm.

Utah (southwestern). Mr. Weidt.

Both of the specimens before me seem to be females, the fifth ventral segment being strongly rounded at apex. This species differs from the preceding in its denser coating of pubescence, shorter but broader head and other characters.

#### **PSEUDALLONYX** n. gen.

This genus resembles *Allonyx* in the structure of the tarsal claws and unguis appendages, but the inner claw is distinctly smaller than the outer and more abruptly bent at apex, and its appendage is larger and thicker and closely adherent to the claw almost throughout its length; the appendage of the outer claw is small and altogether basal. It differs greatly from *Allonyx* in the form of the body, and in having the wide flat punctate and horizontal epipleuræ gradually inflexed upward in plane toward apex. In the structure of the eyes, antennæ and tibiæ it agrees in general with *Allonyx*. I know of but one species at present.

1. **Ps. plumbeus** Lec.—Proc. Acad. Nat. Sci., Phila., 1866, p. 359 (*Allonyx*).

Cuneiform, moderately convex, opaque, the elytra a little less densely so, black; legs pale rufo-ferruginous throughout; pubescence not very coarse, appressed, white and rather long, somewhat dense on the elytra, sparse anteriorly; erect hairs entirely

wanting, the marginal fringe very short dense and posteriorly decumbent. Head small, scarcely more than three-fifths as wide as the prothorax, smoother and finely, sparsely punctate toward the middle, the impressions large but feeble; epistoma rather long, pale, the labrum pale and strongly rounded; eyes moderately large, strongly convex; antennæ rather slender, feebly serrate, one-fourth longer than the prothorax, pale testaceous, darker toward tip, the last three joints larger and blacker, the penultimate joints transverse. Prothorax two-fifths wider than long, widest and rather narrowly rounded just behind the middle, the sides distinctly convergent and straight or just visibly sinuate to apex and base, the basal angles slightly obtuse but not in the least rounded and apparently somewhat prominent; apex arcuato-truncate, much narrower than the base, the latter broadly arcuate, obliquely sinuate laterally; disk densely and finely punctat rugose, obsolete and sparsely punctate, the submarginal excavated line not extending to the apex. Elytra three-fifths longer than wide, gradually wider to about apical third, where they are nearly twice as wide as the prothorax, the apex thence obtusely ogival; lateral edges narrowly reflexed; humeri exposed at base and rounded; disk obliquely and broadly impressed near the base, finely and somewhat closely punctate. Under surface albido-pubescent. Length 3.0 mm.; width 1.4 mm.

Colorado and Arizona. The individual described above is a female, and the fifth ventral is broadly rounded behind. The male is undoubtedly narrower and less dilated behind. The apex of the elytra and the lateral edges to a slight degree posteriorly are rufous or rufescent.

#### **LEPTOVECTURA** n. gen.

Although evidently belonging to the well defined *Allonyx* group of the tribe by reason of thoracic and ungual structure, the single type of this genus differs greatly in general appearance from any of the others in its *Listrus*-like body, with the elytral epipleuræ narrow and gradually disappearing posteriorly in a fine line on the external flank very near the edge as in *Dasytes*. The inner claw has a very large lamelliform appendage, which is apparently closely affixed throughout its length, the outer being simply obtusely swollen or subdentate internally at base.

1. **L. adspersa** n. sp.—Elongate, narrowly oval and not broader behind, strongly convex, black, the legs pale testaceous, the femora infusate above toward apex; antennæ pale, dark near the tip; pubescence moderately dense, composed of closely appressed and rather long broad hairs, which are white and dark brown in color confusedly intermingled throughout, becoming denser and white near the sides and along the base of the pronotum, and altogether white though scarcely denser on the head; scutellum covered with a dense mass of white pubescence; marginal fringe composed of very short, dense and coarse, posteriorly subdecumbent brown hairs. *Head* two-thirds as wide as the prothorax, fully as wide as long, flat, obscurely and finely punctate, the impressions apical and feeble; epistoma pale and well developed, the labrum pale, broadly rounded at apex; eyes small, prominent, at some distance from the base, the neck slightly constricted; antennæ rather long and slender, much longer than the prothorax, the joints oblique at apex, fifth elongate and slightly dilated, the three last slightly larger, the penultimate nearly as long as wide, sixth and eighth slightly smaller. *Prothorax* two-fifths wider than long, not constricted, widest and subprominently rounded just behind the middle, the sides strongly convergent and straight to the apical angles, which are obtuse but not blunt from above, and almost equally convergent and straight to the basal angles, these being acute, everted and minutely prominent; apex arcuate-truncate, narrower than the base which is broadly and arcuately lobed; disk finely, rather closely punctate, the submarginal groove very coarsely excavated, extending almost to the apex and curving inward near the base, becoming obsolete toward the middle. *Elytra* elongate, nearly twice as long as wide, slightly wider than the prothorax, the sides parallel and feebly arcuate, obliquely convergent and arcuate at apex, the immediate tip rather narrowly obtuse; sutural angles acute; punctures fine and moderately close, not very distinct; margins not at all reflexed. Under surface densely clothed with decumbent white pubescence, which is especially dense on the met-episterna and abdomen; legs rather stout. Length 3.0 mm.; width 1.0 mm.

New Mexico.

The fifth ventral segment in the single type before me is strongly rounded at apex. This striking species can be at once identified by its elongate elytra, variegated vestiture and thoracic structure.

#### **MECOMYCTER** Horn.

In this genus the ungual appendages become completely obsolete, the claws being at the same time unusually slender and with a small internal enlargement at base. The epipleuræ are subhorizontal and moderate in width, becoming extinct behind the middle, and the genus further differs from the members of the *Allonyx* group, which it resembles to some extent, in having all the tibiae beset externally with a few blackish spinules, and in the complete

absence of a lateral submarginal line on the pronotum. The elongate head is not strictly peculiar to *Mecomyceter*, as it exists to a pronounced degree also in *Vectura*. The two species can be separated thus:—

Prothorax elongate, without a lateral projection behind the middle.

1. **omalinus**

Prothorax transverse, with a conspicuous projection at the side at basal two-fifths ..... 2. **facetus**

The genus is distributed through the arid regions from Kansas to Arizona.

1. **M. omalinus** Horn—Trans. Am. Ent. Soc., X, 1882, p. 126.

Stout, moderately convex, feebly shining, pale testaceous in color, the base of the head, maxillary palpi, outer seven joints of the antennæ and entire under surface of the hind body, except the mesosternal side-pieces, black or blackish; elytra black, with the apex and an elongate area from the humerus to apical third of each pale testaceous; legs pale throughout; pubescence short, rather sparse, pale in color, the elytra with a few scattered hairs which are slightly longer and more erect; marginal fringe obsolete. Head three-fourths as wide as the prothorax and nearly twice as long as wide, flat and coarsely punctate, the interspaces minutely punctulate; eyes well developed, distant from the base, the neck narrowed toward base; antennæ one-third longer than the prothorax, the first two joints stout, the next two slender, the remaining seven larger and feebly incrassate to the apex, the tenth slightly transverse. Prothorax fully as long as wide, the sides evenly convergent and nearly straight from the oblique and slightly sinuate basal angles to the apex, the apical angles obtuse but not rounded from above, the apex truncate, narrower than the base which is broadly and evenly arcuate; marginal acute line far down on the flanks, very fine, non-serrulate and curving upward in a broad arc toward apex; disk rather coarsely and rugosely punctate. Elytra scarcely one-half longer than wide, feebly dilated behind and more than twice as wide as the prothorax, evenly and broadly rounded at apex; humeri tumid and broadly exposed at base; lateral edges fine and not reflexed; disk coarsely but not densely, subrugosely punctured toward base, very feebly sculptured toward apex. Legs rather long and slender. Length 3.0 mm.; width 1.2 mm.

Kansas. The specimen described is probably a female, the fifth ventral being broadly rounded behind.

2. **M. facetus** n. sp.—Moderately stout and convex, rather shining, pale testaceous in color, the elytra with a sutural area not attaining the apex and sinuately narrowed before the middle of black; under surface of the hind body black, the mesosternum and fifth ventral segment pale; legs pale, the hind thighs infuscate except toward tip; pubescence short, not very dense, pale, rather fine and subdecumbent, intermixed on the elytra with numerous short and more erect hairs of the same color; marginal fringe almost obsolete. *Head* missing in the type. *Prothorax* three-fifths wider than long, the sides subparallel, rather acutely prominent at basal two-fifths, thence feebly convergent and broadly sinuate to the apical angles which are rounded from above, and slightly convergent and nearly straight for a short distance to the basal angles, these being obtuse but evident; base and apex broadly and almost equally arcuate, the former very slightly the wider; disk rather coarsely but feebly, sparsely and somewhat inconspicuously punctate, the marginal acute edge fine, rapidly descending far down the flanks from the base to apical third, then more rapidly and subtransversely ascending in a broad arc. *Elytra* two-fifths longer than wide, only just visibly wider behind and scarcely two-thirds wider than the prothorax, the sides subparallel and feebly arcuate; apex obtuse, broadly truncate toward the middle, the sutural angles right; humeri tumid but not very widely exposed at base; disk rather coarsely but feebly, sparsely and inconspicuously punctate toward base, the sculpture becoming very fine toward apex. Under surface rather thinly clothed with very short, fine and subcinereous pubescence, the legs slender. Length (exclusive of the head) 1.9 mm.; width 0.95 mm.

#### Arizona?

The single specimen, which I found among some discarded material some years ago, is without any indication of locality, but was in all probability taken by Mr. Morrison; it is a male, the fifth ventral being short and broadly truncate, with a small feeble sinuation at the middle of the truncature. I do not think that it could by any possibility be the male of the preceding species, which is known to me only by the female.

#### **DOLICHOSOMA** Steph.

The American type of this genus has no vestige of elytral epipleuræ, the lower edge being acute and without a submarginal line even toward base. This peculiarity necessitates its isolation from all other generic groups of the tribe.

The tarsal claws are stout and strongly developed, the inner having a large corneous internal dilatation in basal half, which is



continued to the apex by the rounded membranous appendage, the latter leaving a small part of the tip of the claw free; the outer claw has the inner corneous dilatation extending far beyond the middle, but the appendage forms merely a membranous terminal margin; the apical portion of the outer claw is more prolonged and arcuate than the corresponding part of the inner claw. The tibiae are altogether devoid of external spinules, but are clothed sparsely throughout with long erect and stiff black hairs, and the pronotum has no trace of a submarginal line. The body is extremely elongate and subcylindrical, differing very much in facies from any other type of the tribe.

Two species may be assigned to this genus as follows, *foveicollis* serving as the type of the above remarks:—

Prothorax one-third wider than long.....1. **foveicollis**  
Prothorax nearly twice as long as wide.....2. **tenuiformis**

This genus seems to occur principally on the eastern slopes of the Rocky Mountains from Texas to Hudson Bay, but probably entered the American continent by way of Siberia.

1. **D. foveicollis** Kirby—Fauna Bor. Am., IV, p. 243 (Dasytes); Lec.: Proc. Acad. Nat. Sci., Phila., 1866, p. 358 (Dolichosoma).

Very elongate, subcylindrical and convex, black with a strong blue reflection; legs black, the antennae black with the second joint, and, to a less degree, the first, testaceous; pubescence stiff, long, erect and black, very sparse, the hairs of the elytra varying in length; marginal fringe completely obsolete; integuments strongly shining. Head five-sixths as wide as the prothorax, wider than long, coarsely and sparsely punctate, convex, with two deep impressions anteriorly which are posteriorly confluent; surface between the antennae tumid; epistoma truncate, the labrum broadly rounded; eyes obliquely oval, not attaining the base, the neck rapidly narrowed behind them; antennae long, compressed, only feebly serrate, much longer than the head and prothorax, not incrassate toward tip, the joints longer than wide. Prothorax one-third wider than long, the sides subparallel and broadly arcuate, feebly convergent and nearly straight posteriorly, the disk widest before the middle, sparsely and very coarsely punctate and slightly uneven; base truncate, with the angles somewhat obtuse; lateral edges very acute. Elytra two and two-thirds times longer than wide, distinctly wider than the prothorax, the sides subparallel

and straight, very gradually oblique and rounded toward apex; sutural angles obtuse and rounded; disk not very coarsely but strongly, very sparsely and rugosely punctate, the interspaces shining and minutely, feebly rugulose. Under surface very sparsely pubescent, the legs long and slender. Length 6.5 mm.; width 1.4 mm.

Nebraska and northward. The male, which is the only sex which I have seen, has a very large and deep anteriorly arcuate excavation at the apex of the fifth ventral, the bottom of the excavation gradually smooth, level, polished and glabrous posteriorly, with a rectilinear and transverse posterior margin, which is less apical than the lateral lobes of the segment; the genital segment is broadly sinuate at apex throughout its width, flat, with all but an abruptly limited lateral area pale and subcoriaceous. The allusion to cinereous hairs by LeConte, in referring to the vestiture of this species, is altogether erroneous.

2. ***D. tenuiformis*** Horn—Trans. Am. Ent. Soc., VIII, 1880, p. 150.

The body in this species is extremely slender and elongate, dark greenish-bronze in color and subopaque above, bluish and shining beneath. Head coarsely punctured, the front triangularly impressed. Prothorax a little narrower than the head, nearly twice as long as wide, with the sides parallel; disk with an impressed median line. Elytra a little wider than the prothorax with the sides straight, nearly three times as long as the head and prothorax, the disk rather coarsely, densely and irregularly punctate, the sutural margin slightly elevated. Length 4 mm.

Texas,—Cab. Horn. This species somewhat resembles the European *D. linearis* in form, according to Dr. Horn; I have seen no representative, and the above statements are taken from the original description.

#### MELYRINI.

This tribe is but poorly represented in the United States by a single small genus on each side of the continent. There can be no doubt at all that both of these genera are different from the European *Melyris*, and I have therefore thought best to give them separate names; they are mutually very distinct themselves, and may be known by the following characters:—

Epipleuræ rather wide and parallel, extending to the sutural angles; last joint of the maxillary palpi conoidal and gradually pointed; body very coarsely and closely cribrate.....**Alymeris**

Epipleuræ moderately wide toward base, gradually becoming obsolete behind the middle of the elytra; last joint of the maxillary palpi obliquely truncate at apex; body sparsely punctured.....**Eurelymis**

The species are generally quite rare and but few examples of the majority of them exist at present in cabinets.

### **ALYMERIS** n. gen.

This genus consists of small or moderate sized species, having the integuments very coarsely, deeply and closely cribrate and the epipleuræ rather wide, with their plane inclined slightly upward and almost equal in width from the base to the sutural angles, differing radically in this respect from any other genus of the family inhabiting the United States; the epipleuræ are flat and finely punctate, and the margins become prominent toward apex, the lower edge being strongly serrulate. The antennæ are short, the maxillary palpi somewhat small in size, the eyes well developed and convex, the sides of the pronotum serrulate, the anterior tibiæ devoid of spinules and the tarsi rather short, with the basal joint quite distinctly shorter than the second, and the fifth joint of the posterior fully as long as the three preceding together; the ungues are slender, with a feeble dentiform internal dilatation at base, the appendages being obsolete. We have three well defined species as follows:—

Elytra dark castaneous, the base and a small spot at the middle of each near the apex pale testaceous; pubescence inconspicuous.....1. **basalis**

Elytra uniform in color, blackish or piceous.

Elytral pubescence inconspicuous; prothorax strongly transverse and rapidly narrowed toward apex.....2. **cribrata**

Elytral pubescence long and distinct; prothorax much less transverse and feebly narrowed toward apex.....3. **floridana**

The species of *Alymeris* are confined to the Atlantic and Gulf regions of the continent from New York to Louisiana.

1. **A. basalis** Lec.—Proc. Acad. Nat. Sci., Phila., VI, p. 171 (*Dasytes*); Class. Col. N. A., 1861, p. 93 (*Melyris*).

Elongate-oval, rather stout, strongly convex, opaque, black, the elytra castaneous with the base and a subapical spot testaceous; legs piceous-black; antennæ piceous, testaceous near the base; pubescence extremely short, sparse and scarcely distinct.

Head strongly deflexed, coarsely retate, the frontal impressions feeble; eyes convex, basal; epistoma with a pale subcoriaceous prolongation, the labrum small, blackish, strongly rounded; antennæ scarcely as long as the prothorax, feebly incrassate, the penultimate joints slightly transverse. Prothorax one-half wider than long, the sides broadly arcuate, more convergent anteriorly; disk opaque and coarsely retate, subexplanate near the lateral edges. Elytra three-fourths longer than wide, distinctly wider than the prothorax, the sides parallel and broadly arcuate, gradually and strongly rounded behind; disk very coarsely and closely cribrate, with faint vestiges of two or three uneven costuliform lines on each. Length 3.3–3.6 mm.; width 1.4 mm.

Georgia to Louisiana. The feeble costuliform lines on the elytra are especially evident in the male, in which sex the fifth ventral is broadly deflexed toward tip, with the apex somewhat sinuate in the middle, and the genital segment thin, pale and coriaceous with its apex broadly and feebly sinuate, and its surface narrowly and abruptly carinate along the middle. The description is drawn from the female, and in the other sex the prothorax is less transverse and less narrowed anteriorly, and the elytra relatively shorter and more obtuse behind. Two specimens.

2. **A. cribrata** Lec.—Proc. Acad. Nat. Sci., Phila., VI, p. 171 (Dasytes); Class. Col. N. A., 1861, p. 93 (Melyris).

Resembles *basalis*, but smaller, less stout and with the elytra uniformly piceous throughout, the epistoma and labrum pale; pubescence short, sparse and scarcely distinct. Length 2.2–2.6 mm.; width 0.8–1.0 mm.

Middle and Southern States. This species is not rare, and may be distinguished readily by the characters given in the table. In the male the shining surface of the fifth ventral is gradually deflexed toward tip, the latter truncate; the genital segment is small and has a strong median carina.

3. **A. floridana** n. sp.—Rather stout and convex, gradually broader behind, dull anteriorly, the elytra shining; body black, the elytra rather pale and piceous; legs piceous-brown, the femora blackish; antennæ blackish, the two basal joints pale; pubescence dark fulvo-cinereous, suberect, fine and rather dense anteriorly, long coarse and very sparse on the elytra. *Head* four-fifths as wide as the prothorax, dull and retate, smoother near the apex, not impressed; epistoma pale and well developed, the labrum pale and strongly rounded; eyes moderate in size and convexity; antennæ very short, about as

long as the prothorax, the fourth joint very oblique, fifth larger than any of the following, six to ten equal, compact, more pubescent and distinctly transverse, eleventh moderate in size, obtuse. *Prothorax* one-half wider than long, the sides rounded toward base, strongly serrulate, the apex and base subequal, broadly arcuate; basal angles obtuse but not obliterated; disk opaque and coarsely, polygonally retate, not explanate at the sides. *Elytra* short, scarcely more than one-third longer than wide, the sides nearly straight and gradually divergent from the base, at apical third about two-fifths wider than the prothorax; apex very obtuse; disk with very large, perforate and close-set foveæ, the bottoms of which are smooth, thin and perfectly transparent. Under surface shining and scarcely at all pubescent, the legs rather short. Length 1.75–1.8 mm.; width 0.85–0.9 mm.

Florida (Key West). Mr. Schwarz.

The male, serving as the type, has the fifth ventral very short, not deflexed and broadly truncate at apex, with a rounded shallow sinuation at the middle, the genital segment large and wide, feebly arcuato-truncate throughout at apex and with a transverse abrupt and flat-topped elevation on the surface at apex, the anterior margin of which is arcuate and coincident in size and curvature with the median sinus of the fifth segment, these characters being quite different from those of the two preceding species. In the female the body is still more strongly cuneiform, the elytra longer, paler and more oval, the head and prothorax smaller, and the fifth ventral short, flat and broadly rounded. Two specimens.

#### **EURELYMIS** n. gen.

The representatives of this genus differ very radically from *Alymeris* in several particulars. The epipleuræ are very narrow and gradually become extinct far before the apex of the elytra; the tarsi are long, filiform and very slender, with the basal joint only slightly shorter than the second and the latter fully as long as the fifth. The antennæ are better developed and are strongly serrate toward apex, and, finally, the fourth joint of the maxillary palpi is obliquely truncate at apex, thus leading feebly toward the next subfamily. The eyes are large, prominent and basal, rounded and with a small feeble anterior sinuation, but are glabrous and not distinctly less finely faceted than usual. The sculpture of the body is much finer and sparser than in the preceding genus, but the lateral edges of the prothorax are quite as distinctly serrulate, the edges of the elytra, however, being almost perfectly even throughout. In one of the sexes there is, in all the species, an el-

liptical area on each elytron near the apex which is polished and impunctate, and of which there is no trace in the other; in neither sex is there any trace of costuliform lines on the elytra.

The species appear to be local and rare, and are distributed over the dry regions of the great interior basin west of the Rocky Mountains; the three known to me may be known as follows:—

Legs black, more or less paler distally.

Prothorax widest at or very near the base; the sides convergent and feebly arcuate throughout.....1. **speculifer**

Prothorax more arcuate at the sides toward base, and widest at a short distance behind the middle.....2. **atra**

Legs pale flavo-testaceous throughout.....3. **flavipes**

In general appearance these species are remarkably homogeneous among themselves.

1. **Eu. speculifer** n. sp.—Oblong, stout and strongly convex, dull, the elytra shining; under surface polished; body deep black throughout, the legs black with the tibiae and tarsi gradually paler; antennae blackish, pale toward base; pubescence very sparse, decumbent, moderate in length, dark in color and entirely inconspicuous. *Head* small, about one-half as wide as the prothorax, the sculpture shallow but scabro-punctate, smooth toward apex; occiput feebly impressed along the middle, the frontal impressions obsolete; epistoma short and wide, with a fine pale coriaceous margin; labrum short and very broad, transversely rounded, rather dark in color; eyes moderately large; antennae a little longer than the prothorax, the two basal joints slightly stout, the next two narrow, the fifth wider, six to ten still wider, rather compact, strongly transverse, forming a broad pubescent and serrate club, the eleventh moderate in length. *Prothorax* two-thirds wider than long, trapezoidal, the sides strongly convergent from base to apex and feebly, almost evenly arcuate, the apex arcuate; apical angles rounded, the basal obtuse; disk densely and coarsely but shallowly sculptured, the large umbilicate punctures connected by anastomosing raised lines, forming still larger polygonal meshes, the sculpture but slightly stronger toward the sides. *Elytra* nearly three-fourths longer than wide, distinctly wider than the prothorax, the sides parallel and nearly straight; apex obtuse, the sutural angles broadly rounded; disk sparsely punctate, the punctures gradually coarse toward base, fine posteriorly, becoming denser and rugulose very near the apex. *Abdomen* feebly punctulate, finely and sparsely pubescent, the legs rather long and slender. Length 4.25–4.4 mm.; width 1.75–1.85 mm.

Utah (southwestern). Mr. C. J. Weidt.

The type is a male, and in that sex the fifth ventral is much longer than the fourth and very broadly and feebly sinuate toward the middle of the apex. In the female the form throughout is similar, but each elytron has an oval, subapical, polished and

more convex spot, and the fifth ventral has a very small circularly rounded median nick, the genital segment being flexed upward in plane, with a large triangular apical emargination. Other than the median nick, the fifth ventral of the assumed female is rounded behind, and, as the antennæ seem to be more slender and the body larger in this specimen,—having the subapical mirrors—it is probable that Dr. LeConte was correct in his identification of the sexes. Two specimens.

2. **Eu. atra** Lec.—Bull. U. S. Geol. and Geog. Surv., 1878, IV, p. 461 (Melyris).

There is no representative before me of either this species or the next, but from some drawings and notes made from the original types a few years since, it is apparent that *atra* is nearly identical in sculpture and pubescence to *speculifer* and *flavipes*, but is rather narrower, more parallel and straighter at the sides and a little more depressed; legs as in *speculifer*. It differs decidedly from both in the shape of the prothorax, which is more rounded at the sides and widest at a much greater distance from the base. Length 3.7 mm.; width 1.5 mm.

Colorado (Beaver Brook—6000 ft.),—Cab. LeConte. The female is the only sex known.

3. **Eu. flavipes** Lec.—Bull. U. S. Geol. and Geog. Surv., 1878, IV, p. 461 (Melyris).

This species exactly resembles *speculifer*, but is smaller and with the legs pale flavate throughout and a little shorter. The hind tarsi are very nearly as long as the tibiæ. In sculpture and vestiture it is similar to *speculifer*, except that the minute reticulations of the elytra are more obliterated. Length 3.4–3.8 mm.; width 1.3–1.6 mm.

California,—Cab. LeConte. This species probably does not extend westward beyond the Sierras.

#### RHADALINÆ.

#### **RHADALUS** Lec.

In this genus the body is larger than in the preceding subfamily, and clothed with long bristling pubescence. The ungual appendages are slender, equal, not as long as the claws and wholly

detached from them except at base, the tarsi moderate in length, with the first and second joints equal, clothed with long erect hairs above and long dense and coarse hairs beneath, and the anterior tibiæ have a few long slender external spines. The maxillary palpi are long, with the last joint large and in the form of a right-angled triangle, about twice as long as wide, the terminal joint of the labial palpi being moderately dilated and transversely truncate at apex. The antennæ are long, serrate, with the joints elongate and acutely pointed internally at apex, and the eyes are large, entire, sparsely setose and with the facets very large and convex. The epistoma is large, bisinuate at base, coriaceous at apex, and the labrum strongly transverse, arcuately truncate at tip and with the surface somewhat impressed at the apex. The epipleuræ are moderate in width, flat and horizontal, with the plane gradually inflexed posteriorly, not attaining the apex of the elytra.

The two species may be distinguished as follows:—

Eyes separated on the front by much less than twice their own width; prothorax very much narrower than the elytra.....1. **testaceus**  
 Eyes very much smaller, separated on the front by nearly three times their own width; prothorax almost as wide as the elytra.....2. **lecontei**

The punctures of the head and pronotum are coarse, irregular, sparse and unevenly distributed, and each is excavated in the summit of an elevated tubercle, this form being evidently evolved gradually from the asperate puncture, having its anterior margin elevated.

This genus seems to be confined largely to the desert regions of southern Arizona.

1. **R. testaceus** Lec.—Ann. Lyc. Nat. Hist., N. Y., V, p. 212.

Elongate, subparallel, strongly convex, pale brown in color, the antennæ, legs and under surface, except the sterna, still paler and more flavate; integuments shining and smooth between the punctures; pubescence very long, erect, pale yellowish in color, rather sparse but very conspicuous on every part of the body and legs. Head only slightly narrower than the prothorax, blackish at base; antennæ very slender, not incrassate, about one-half as long as the body. Prothorax transversely elliptical, fully three-fourths wider than long, the sides parallel and evenly, strongly arcuate; disk evenly convex, very sparsely and coarsely punctate. Elytra nearly twice as long as wide and about one-



half wider than the prothorax, parallel, evenly rounded behind, rather coarsely, evenly and sparsely perforato-punctate. Length 5.8 mm.; width 2.2 mm.

Arizona,—Cab. LeConte. The specimen described seems to be a female, the fifth ventral being evenly and broadly rounded behind, the genital segment thin, flat, coriaceous and almost circularly rounded.

2. **R. lecontei** n. sp.—Oblong-oval, stout and strongly convex, somewhat shining, pale castaneous in color, the legs and antennæ throughout paler and more flavate; pubescence pale, sparse but very long, erect and bristling from every part, with some shorter and more decumbent hairs of the same color. *Head* wider than long, three-fourths as wide as the prothorax, the eyes at some distance from the base; antennæ slender, gradually attenuate toward apex, not two-fifths as long as the body, the joints elongate, the second much the smallest. *Prothorax* three-fourths wider than long, almost evenly elliptical, the sides parallel, evenly and strongly arcuate, and the angles all broadly rounded and obsolete; apex and base arcuate; lateral edges finely serrulate; disk evenly convex, coarsely and irregularly punctate, the punctures dense in parts. *Elytra* three-fourths longer than wide, slightly wider than the prothorax, parallel and straight at the sides, the apex evenly rounded; sutural angles right and not in the least blunt; side margins finely reflexed, the concavity with a single series of more pronounced punctures; disk very coarsely and deeply perforato-punctate, the punctures uneven in size and separated by but little more than their own widths. *Abdomen* finely, sparsely punctulate, the legs long and moderately slender. Length 5.8 mm.; width 2.5 mm.

Arizona (Benson). Mr. Dunn.

The single type before me is evidently a female, the fifth ventral being flat and very evenly rounded behind. This species differs from *testaceus* in its stouter form, relatively much larger prothorax, smaller head with very much smaller eyes, and in its closer and coarser punctuation.

---

Since this revision of the Melyridæ was written, I have received a tolerably complete set of the European genera, and find that there is in general but little affinity with our representatives of the family, the American species being smaller, duller and much less conspicuous insects as a rule. The American *Dasytes* and *Dolichosoma* are evidently congeneric with the European, or at any rate very closely allied, but all our other genera, including *Alymeris* and *Eurelymis*, are widely different from their most closely related European analogues.

## SCARABÆIDÆ.

**POLYPHYLLA** Harris.

The species described below is one of the allies of *decimlineata*.

**P. pacifica** n. sp.—Oblong-oval, convex, piceous-black, the prothorax pale and bright red-brown; sterna pale, the abdomen blackish with the posterior half of the fourth and the entire fifth segment red; femora pale rufous, the tibiæ and tarsi darker; vestiture much sparser than in *decimlineata* but almost similarly disposed and colored, the yellow scales extremely large and broad and the oblique white humeral vitta very narrow and rather short, the submarginal stripe beginning at some distance behind the humeri; pygidium very sparsely clothed, having large broad scattered yellowish scales intermingled with fine sparse hairs, almost completely glabrous toward apex and deeply impressed in the middle near the base. *Head* less than one-half as wide as the prothorax, the clypeus truncate with obtuse angles, broadly arcuate toward the middle; punctures deep and well separated; antennal club nearly three-fifths as long as the entire stem. *Prothorax* quite distinctly more than twice as wide as long, broadly subangulate at the sides just behind the middle, the apex slightly more than two-thirds as wide as the base; disk coarsely and very sparsely punctate, finely, densely so and covered densely with white scales along the impressed median line and in a small discal spot at lateral fifth and just behind the middle. *Elytra* one-half longer than wide, two-fifths wider than the prothorax, the sides parallel and rather strongly arcuate. Length 25.0 mm.; width 13.6 mm.

California.

This species differs from *decimlineata* in coloration, in its smaller size and rather stouter form, sparser and very much broader scales, very much shorter, broader and more sparsely clothed pygidium, shorter and stouter hind femora and numerous other features. It is represented by a single female from the Levette cabinet.

**THYCE** Lec.

The following species differs widely from any other thus far discovered in the form of the prothorax:—

**T. pistoria** n. sp.—Stout, oval and convex, pale brownish-testaceous throughout, the vestiture short, white and very dense, the hairs slightly stout but not at all squamiform, denser near the sides of the pronotum and extremely dense on the scutellum, slightly denser on the pygidium than on the elytra, intermingled on the head and pronotum with numerous fine erect and pale silky hairs, the latter extremely long and dense beneath throughout the extent of the sterna; abdomen uniformly clothed like the elytra but sparsely so along the middle, especially near the apex. *Head* scarcely more than two-fifths as wide as the prothorax, the clypeus broadly arcuato-truncate and feebly

reflexed at apex, the angles broadly obtuse and rounded; antennal club well developed and as long as the first four joints of the stem, the fourth palpal joint twice as long as wide, obliquely pointed, excavated as usual and just one-half as long as the antennal club. *Prothorax* scarcely more than one-half wider than long, the apex not more than two-thirds as wide as the base, the sides strongly convergent and only very feebly arcuate from base to apex, just visibly more prominent a little before the middle; apex feebly emarginate; base strongly and arcuately lobed in the middle, the basal angles rounded; disk rather finely, indistinctly and densely punctate. *Elytra* but slightly longer than wide and nearly one-half wider than the prothorax, the sides parallel and somewhat strongly arcuate; disk feebly and not very densely punctate. Pygidium three-fifths wider than long, moderately convex. Abdominal segments connate, the fifth alone free as usual. Length 19.0 mm.; width 10.5 mm.

California (Los Angeles). Mr. Rivers.

This species may be distinguished at once by the outline and size of the prothorax, the sides being straighter and more convergent from base to apex than in any other known to me. I have before me only a single male, another perfectly similar specimen being at present in the cabinet of Mr. Rivers.

**T. riversi** n. sp.—Oblong-oval, convex, somewhat shining, pale brownish-testaceous throughout, the knees minutely blackish; body clothed rather sparsely with fine decumbent yellowish hairs, denser along the median line and toward the sides of the pronotum; head, pronotum, sterna and femora clothed in addition with long erect and conspicuous yellowish pile. *Head* much less than one-half as wide as the prothorax, the clypeus narrowed at base, strongly concave, broadly arcuato-truncate at apex with the angles blunt and rounded; antennae well developed, the club almost as long as the stem; fourth palpal joint rather small, excavated, two-fifths as long as the antennal club. *Prothorax* slightly less than twice as wide as long, broadly subangulate at the sides just behind the middle, the angle rounded, the disk at this point much wider than at base; apex two-thirds as wide as the base, broadly, circularly emarginate, the base arcuately lobed in the middle, the angles obtuse but very distinct and only slightly blunt; disk rather coarsely deeply closely and distinctly punctate. *Elytra* nearly one-fourth longer than wide, fully two-fifths wider than the prothorax; sides parallel, somewhat arcuate toward apex, the latter very broadly arcuato-truncate; disk somewhat coarsely, sparsely, unevenly and rather feebly punctate, the sculpture finer and denser along the suture. Pygidium feebly transverse, moderately convex, rather finely but subrugosely punctate, sparsely pubescent, subglabrous near the apex. Length 20.0–23.0 mm.; width 10.0–12.0 mm.

California (Los Angeles).

The description given above is drawn from the male, and the female, judging from a specimen before me, is larger, with the vestiture rather dense, the antennal club being oval and but

slightly more than twice as long as wide. In one respect *riversi* differs from all the other members of this genus, the female being more densely and conspicuously clothed than the male; it is possible, however, in spite of general facies, that this female does not really belong to the same species, especially as the basal angles of the prothorax are broadly rounded. The hairs are much finer than usual.

The two examples in my cabinet were kindly communicated by Mr. J. J. Rivers, who possesses a considerable series.

These species should both be placed between *carpenteri* and *squamicollis* in the table previously published by me (Col. Not. I, p. 170).

It is impossible to properly associate the males and females in this genus unless they be collected at the same time and place, and it is consequently seldom prudent to base a species upon the female alone.

#### **XYLORYCTES** Hope.

**X. faunus** n. sp.—Moderately stout, strongly convex, polished, black throughout above, dark red-brown beneath, the tibiae and tarsi somewhat piceous in tinge; under surface clothed with long brownish-red hair, the upper surface and pygidium glabrous.

*Male*—Head less than one-third as wide as the prothorax, the clypeal apex reflexed and bilobed; dorsal horn nearly in *satyrus* but shorter. Prothorax three-fourths wider than long, widest near the middle, the sides rounded, strongly convergent, anteriorly; discal declivity beginning at the middle when viewed from above, deep, somewhat excavated, its posterior margin prominent but rounded in the middle, its surface covered sparsely with transversely sub-crescentiform punctures, the posterior elevated surface coarsely and densely punctured anteriorly at the sides. Elytra nearly as long as wide, equal in width to the prothorax and twice as long, obsoletely striato-punctate. Pygidium two and one-half times as wide as long.

*Female*—Scarcely at all narrower than the male, the head nearly as in *satyrus*. Prothorax two-thirds wider than long, evenly convex but feebly impressed and more densely and roughly punctured near each apical angle; sides evenly convergent and broadly arcuate from near the base, the basal angles broadly rounded. Elytra very nearly as long as wide, more deeply striate than in the male, the pygidium more canaliculate along the lower margin.

Length 28.0–30.0 mm.; width 15.0 mm.

Arizona.

This species differs from *satyrus* in its narrower and more elongate form. The male differs from the corresponding sex of *satyrus* in having the vertical wall of the thoracic depression

begin at the middle of the length instead of just behind apical third when viewed perpendicularly, and the female differs from the female of that species in its less transverse prothorax, with the sides evenly convergent and rounded throughout and in its relatively longer elytra. Three specimens.

*Satyrus* was attracted abundantly to the electric lights at Austin, Texas, in June some years since; both sexes are quite constant in form through a large series.

## TENEBRIONIDÆ.

### CONIONTIS Esch.

The following singular form may be placed near *subpubescens* in the table published by the writer some years ago (Col. Not. II, p. 372).

**C. globulina** n. sp.—Short and broadly oblong-oval, strongly convex, dull, clothed sparsely with rather long decumbent yellowish hairs, black, the legs dark piceo-rufous; elytra strongly descending posteriorly in profile. *Head* a little less than one-half as wide as the prothorax, finely feebly and sparsely punctate, the epistomal sinus moderately deep; antennæ about as long as the prothorax, stout, black, pale at apex and toward base. *Prothorax* a little less than twice as wide as long, the apex scarcely two-thirds as wide as the base, the sides very evenly arcuate; basal angles rounded and but slightly posteriorly oblique at base; apical angles broadly rounded, the apex moderately emarginate in circular arc; disk rather finely but strongly, moderately sparsely and almost equally punctate throughout from side to side; marginal bead fine. *Elytra*, viewed perpendicularly, very short, not as long as wide and not twice as long as the prothorax, deeply vertical in profile toward apex, very finely, feebly, sparsely punctate and feebly, indefinitely uneven and opaque; epipleuræ narrow, gradually hollowed toward base and apex. *Legs* rather long. *Propleuræ* longitudinally wrinkled and polished. Length 6.6 mm.; width 3.7–4.3 mm.

California (Tahichipi Pass). Mr. Wickham.

Recognizable at a glance by its peculiar short broad form, dull and feebly punctate surface and distinct pubescence. Two specimens.

**C. farallonica** n. sp.—Elongate, subelliptical, moderately convex, the sides parallel; integuments polished throughout, subglabrous, each puncture with a very small hair; color piceous-black, often pale castaneous from immaturity; legs not distinctly paler; antennæ rufous, more flavate toward tip. *Head* two-fifths as wide as the prothorax, strongly coarsely and somewhat closely punctured, the epistomal sinus distinct and circularly rounded; anten-

næ slender, distinctly shorter than the prothorax, the eighth joint as long as wide, tenth transverse, third one-half longer than the fourth. *Prothorax* three-fourths wider than long, the apex two-thirds as wide as the base; sides feebly convergent and almost straight from the base to about apical third, then broadly rounded to the apical angles, which are rounded and blunt, the apex broadly emarginate in circular arc; base straight, distinctly oblique posteriorly toward the sides, the angles rather acute and prominent; disk strongly and coarsely but not densely punctate toward the sides, gradually much more finely and remotely so toward the middle; marginal bead thick and rounded. *Elytra* one-half longer than wide, two and one-half times as long as the prothorax and equal in width to the latter, the sides parallel and nearly straight; apical two-fifths evenly ogival; disk feebly uneven, strongly so toward apex, where the coarse but rather sparse punctures bear somewhat long decumbent hairs; punctures equally coarse throughout, the surface highly polished. *Abdomen* distinctly but sparsely punctate, the posterior legs long. Length 10.0–11.5 mm.; width 4.75–5.0 mm.

California (Farallone Islands). Mr. Fuchs.

By certain reflections the elytra seem to have each three fine feeble and irregular raised lines in addition to the other sculpture. Six specimens.

This species may be placed between *viatica* and *eschschoeltzi* in the table before mentioned, differing from the former in its coarse sculpture, and from the latter in its much narrower form, polished pronotum and many other characters. The Farallone Islands are about thirty miles from San Francisco and are in deep water.

#### CÆLUS Esch.

A revision of this genus, together with a description of the larva of *C. ciliatus*, was given in the first part of the present series of papers (p. 178), and the classification suggested below is based largely upon the characters there employed. The species of *Cœlus* are becoming moderately numerous, as the search for them becomes more systematic, and the six known to me at present may be recognized by the following differential statement:—

*Epistoma* deeply sinuate, the sides anteriorly prominent though rounded.

Antennal club subquadriarticulate; pronotum sparsely and less coarsely punctate, with large impunctate areas; body very large....**grossus** Csy.

Antennal club triarticulate; pronotum coarsely and somewhat closely punctate throughout; body much smaller.....**globosus** Lec.

*Epistoma* very broadly and feebly sinuate, the sides broadly rounded and not anteriorly prominent.

Pronotal punctures rather coarse, sparse and unevenly disposed, the surface wholly impunctate in large areas before the middle of the disk.

**arenarius** Csy.

Pronotal punctures coarse and rather close-set throughout the disk, though unevenly distributed; body very much more broadly oval...**latus** n. sp.

Pronotal punctures fine and sparse, somewhat evenly distributed over the entire disk.

Body elongate-oval; sides of the prothorax rather feebly arcuate.

**ciliatus** Esch.

Body short and broad, the elytral asperities smaller, more distinctly defined and more isolated; sides of the prothorax strongly arcuate; head relatively smaller in size.....**curtulus** n. sp.

All of the species have long coarse hair well developed along the sides of the body, its function probably being to maintain the spiracles free from sand while burrowing.

**C. latus.**—Very broadly oblong-elliptical, moderately convex, polished, deep black, the legs dark piceo-rufous; palpi and antennæ paler, testaceous, the labrum blackish; pubescence very short, sparse, yellowish, becoming long at the sides of the body, short and very stiff on the legs. *Head* not two-fifths as wide as the prothorax, coarsely and densely punctured, less closely so on the epistoma, subimpunctate toward base, the epistomal suture marked by a deep transverse channel; apical sinuation very broad and feeble; antennæ with the club three-jointed and feeble, the joints strongly transverse, the last narrower as usual. *Prothorax* distinctly more than twice as wide as long; apex one-half as wide as the base and deeply emarginate, the angles narrowly rounded; sides strongly convergent from the base, arcuate, more strongly so at base, the basal angles obliterated; base transverse and almost rectilinear throughout, with the usual fine coriaceous margin; disk coarsely deeply and conspicuously punctate, the punctures generally rather close-set but uneven in distribution. *Elytra* barely as long as wide, about twice as long as the prothorax, coarsely asperate and polished. Length 7.7 mm.; width 4.8 mm.

California (San Diego).

At first sight this species might be mistaken for *globosus*, but may be readily distinguished by its very much more broadly rounded form and very shallow epistomal sinus.

**C. curtulus.**—Broad and oblong-oval, convex, polished, the elytra dull toward apex, black, the under surface and legs dark rufo-piceous, the trophi and antennæ still paler and rufous; surface glabrous except posteriorly and at the sides of the body. *Head* rather small, barely two-fifths as wide as the prothorax, roughly sculptured, the epistoma smoother, the suture deep; apical sinus broad and feeble but stronger than in *ciliatus*; labrum feebly sinuato-truncate at apex. *Prothorax* short and transverse, slightly more than twice as wide as its greatest length, the apex more than one-half as wide as the base;

sides strongly arcuate; disk rather finely but strongly, sparsely punctate, more densely so and somewhat scabrous toward the sides. *Elytra* short, not quite as long as wide, equal in width to the prothorax, broadly rounded behind, the asperities moderate in size, feeble toward base, closer and stronger toward apex. Length 5.5 mm.; width 3.4 mm.

California (San Francisco).

In *ciliatus* the prothorax is less strongly narrowed from base to apex, not more than twice as wide as its maximum length and is scarcely more than twice as wide as the head, and the elytra are much more densely asperate. The proportions of the typical *ciliatus* are 6.5 by 3.8 mm. I have carefully collected large colonies of *ciliatus*, and believe that there are several forms which are at least racial or varietal, some localities yielding specimens of a very much larger average size than others, with differences in color, relative size of the head, sculpture and other minor features.

#### **EUSATTUS** Lec.

The following species is allied to *dubius* Lec., differing in its smaller size and dull integuments:—

**Eu. nanus** n. sp.—Oblong-oval, strongly convex, dull, the pronotum more shining and simply alutaceous, deep black, the antennæ, labrum, trophi and tarsi dark rufous, subglabrous, each puncture bearing a very small decumbent hair more noticeable near the sides of the pronotum, the hypomera with long projecting hairs near the edges. *Head* one-half as wide as the prothorax, strongly but not very densely punctate, the occiput impunctate; epistoma moderately sinuate in the middle, the margin abruptly reflexed; antennæ slender. *Prothorax* twice as wide as long, the apex deeply emarginate and three-fifths as wide as the base, the latter deeply bisinuate, with the angles posteriorly acute and prominent; apical angles advanced and narrowly rounded; sides evenly and rather strongly rounded; basal margin with a fringe of very short yellowish hairs; disk finely and sparsely punctate, narrowly reflexo-explanate at the sides, the punctures very minute and feeble toward the middle. *Elytra* quite distinctly longer than wide, slightly more than twice as long as the prothorax and barely as wide, subovate, the sides arcuate; apex broadly rounded, the apical margin feebly subexplanate; disk slightly uneven, finely sparsely and submuricately punctured. *Epipleuræ* narrow throughout, glabrous, sparsely wrinkled, deeply impressed near the apex, the outer margin descending. *Abdomen* finely granulato-reticulate, convex, alutaceous, very finely feebly and sparsely punctulate, each puncture bearing a small decumbent hair; legs sparsely and coarsely sculptured, the femora sparsely and coarsely pubescent. Length 6.0–8.0 mm.; width 3.4–4.8 mm.

California (Kern Co.).



One of the smallest species of the genus, distinguishable from *dubius* by its duller and blacker integuments, much less deeply sinuate epistoma and by its relatively less transverse and abbreviated prothorax, which, in *dubius*, is about one-third as long as the elytra. In *nanus* the sides of the prothorax are much less convergent anteriorly than in *dubius*, and the general form of the body is shorter and broader.

### CONISATTUS n. gen.

Body oblong, subglabrous, the antennæ long and slender, the anterior tibiæ produced externally at apex and the base of the prothorax transverse and straight, becoming feebly and posteriorly oblique near the sides

This genus is closely allied to *Eusattus*, differing in the transverse and not bisinuate base of the prothorax; it is founded upon a single small species which may be described as follows:—

**C. rectus** n. sp.—Oblong, strongly convex, rather dull, blackish-castaneous in color, the elytral suture narrowly rufescent; legs dark rufous; antennæ and trophi paler and more flavate; integuments subglabrous, the punctures toward the sides of the upper surface bearing short inconspicuous hairs, the outer edge of the epipleuræ with a long fringe visible toward base, the under surface of the the concave and longitudinally rugose propleuræ without long hairs; basal margin of the pronotum completely devoid of hairs, the apical margin with an extremely short fringe. *Head* nearly one-half as wide as the prothorax, convex and declivous, feebly impressed at the middle of the vertex, finely but strongly, sparsely punctate, more finely and densely so anteriorly, the epistomal suture obsolete except at the sides, the apical margin feebly reflexed only at the sides, feebly sinuate at the middle; antennæ slender, not quite as long as the head and prothorax, the joints elongate, third only slightly longer than four to seven, club gradual and feeble, ninth joint longer than wide, the tenth wider than long, eleventh oval and slightly elongate; mentum flat, transverse, emarginate in circular arc; ligula angularly emarginate; last joint of the maxillary palpi elongate, obliquely truncate at apex; eyes half divided. *Prothorax* not quite twice as wide as long, the apex deeply emarginate and two-thirds as wide as the base; apical angles advanced but obtuse, the basal right and slightly blunt, not prominent; sides evenly arcuate; disk rather wider at basal third than at base, strongly, somewhat irregularly but not densely punctate near the sides, finely sparsely and feebly so toward the middle; side margins very narrowly subexplanate and not beaded. *Scutellum* triangular. *Elytra* longer than wide, barely as wide as the prothorax and between two and three times as long, the sides feebly arcuate; apex slightly produced and conjointly narrowly rounded; disk finely wrinkled and with small moderately close-set, submuricate punctures. *Abdomen* polished, sparsely

but rather strongly punctured and somewhat pubescent; legs rather long, the tarsi long and slender, the first joint of the anterior simple. Length 6.8 mm.; width 3.3 mm.

Oregon (Squally Hill). Mr. Schwarz.

The epipleuræ are moderately wide, inclined in plane, gradually very narrow to the apex, sparsely punctate and glabrous.

### CÆLOCNEMIS Mann.

**C. sulcata** n. sp.—Elongate and moderately stout, strongly convex, deep black and dull throughout. *Head* one-half as wide as the prothorax, truncate at apex, minutely feebly and sparsely punctate throughout; antennæ about as long as the prothorax, dull, minutely punctulate, each puncture bearing a minute decumbent hair, third joint one-half longer than the fourth and scarcely more than twice as long as wide, eleventh joint wider than long, very obliquely pointed, the sensitive pores distinct and close-set. *Prothorax* not quite as long as wide, widest at the middle where the sides are broadly angulate, thence broadly arcuate and feebly convergent to the apex and slightly more convergent and broadly, evenly and very feebly sinuate throughout to the base, the latter truncate and slightly narrower than the apex, which is also truncate with the angles broadly rounded; basal angles slightly acute and prominent, not rounded; disk extremely minutely but deeply punctate, the punctures rather sparse, distinct under sufficient power and each lying within a large feeble dent of the surface, the latter producing a very obsoletely rugose appearance. *Elytra* oval, not quite twice as long as wide, two and one-half times as long as the prothorax and about one-fourth wider, arcuate at the sides, the apex feebly produced and conjointly, evenly parabolic; disk finely but deeply sulcate, the sulci minutely, not closely punctate, the intervals convex, nearly smooth and extremely finely, sparsely punctulate. *Legs* long and sparsely punctate; tibiae densely and compactly fulvo-pubescent within toward apex as usual, the tarsi similarly clothed beneath. Length 26.0–28.0 mm.; width 9.0–10.0 mm.

Utah (southwestern). Mr. C. J. Weidt.

This distinct species differs from *punctata* in its much larger size, sulcate elytra and finer sculpture. According to Mr. Weidt it occupies a very different station from *punctata*, one being found only in the low sun-scorched plains, and the other in the high moist wooded regions.

### BLAPSTINI.

There are several elements useful in the classification of the genera of Blapstini, which, although apparently trivial in themselves, are undoubtedly sound with the limits of this particular group of genera. The two to which attention should be parti-

cularly drawn are: the form of the basal margin of the prothorax, and the presence or absence of a fringe of setæ along the lateral edges of the body. A mere casual inspection of the numerous species of *Blapstinus*, and of the otherwise evidently distinct though fewer representatives of *Mecysmus*, will show that the bisinuate form of base is perfectly constant throughout the former, and that the transversely rectilinear form is equally persistent in the latter; consequently it must be evident that the form of the base is of great importance, and the separation of *Cybotus* and *Aconobius* on this feature alone would be more than amply justified, irrespective of the profound differences in habitus distinguishing both of these genera. *Cybotus* is however further characterized by an abnormality of palpal structure, and *Aconobius* by the presence of a dense fringe along the sides of the body, which, in conjunction with its peculiar antennæ, gives it a very striking facies.

The marginal fringe is chiefly important in discriminating certain wingless genera, which constitute the division with connate elytra and abbreviated scutellum. Its importance is demonstrated by its absolute constancy throughout those polytypic genera which happen to possess it, such as *Ulus* and *Notibius*, and there can be no doubt that it is an important generic character, probably developed by reason of changes in the life-habits of the species. The characters here used to separate *Nocibiotes*, *Tonibius* and *Tonibiastes* are based upon types of elytral sculpture, bodily facies and antennal structure, which are invariable throughout the respective genera where enough species are known to test their constancy, and it is probable that these genera will ultimately hold good. *Conibius*, as here defined, is still somewhat heterogeneous, containing three subgeneric types as noted below.

The genera of *Blapstini* may be separated as follows:—

Scutellum triangular, separating the elytra at base, the hind wings frequently well developed and the anterior tarsi of the male dilated as a rule.

Base of the prothorax bisinuate.

Anterior tibiæ bent; vestiture dual in structure.....**Trichoton**

Anterior tibiæ straight; pubescence simple.

Body generally oval, fimbriate at the sides; anterior tibiæ produced externally at apex.....**Ulus**

Body usually oblong or oblong-oval, the sides not fimbriate; anterior tibiæ simple.....**Blapstinus**

Base of the prothorax not bisinuate.

|   |                    |
|---|--------------------|
| The base straight and as wide as that of the elytra; body broadly oval and strongly convex.....   | <b>Cybotus</b>     |
| The base straight and narrower than that of the elytra; body elongate and subdepressed.....   | <b>Mecysmus</b>    |
| The base evenly arcuate; body narrow and convex, densely fimbriate at the sides.....  | <b>Aconobius</b>   |
| Scutellum very short and broad, not entering the disk of the elytra; body always completely apterous, the anterior tarsi never dilated in the male. |                    |
| Prothorax not at all fimbriate at the sides.  |                    |
| Elytra not sulcate, the antennæ stout, generally feebly and very gradually incrassate toward tip and without an abrupt club.....                    | <b>Conibius</b>    |
| Elytra sulcate.   |                    |
| Antennæ with an abrupt three-jointed club; elytral intervals convex and asperate.....   | <b>Nocibiotes</b>  |
| Antennæ with a feebly differentiated club; elytral intervals convex and simply punctate; prothorax not narrowed behind.....                         | <b>Tonibius</b>    |
| Antennæ not described; elytral intervals acutely costiform; prothorax narrowed behind .....   | <b>Tonibiastes</b> |
| Prothorax densely fimbriate along the lateral edges.  |                    |
| Anterior tibiæ narrow and non-fossorial; body narrow and parallel.  |                    |
|   | <b>Conibiosoma</b> |
| Anterior tibiæ broadly triangular and compressed; body stout and oblong-oval.....   | <b>Notibius</b>    |

In this table the first five genera and *Conibiosoma* remain with the scope originally given them (Col. Not. II, p. 409). *Aconobius* is founded upon *Conibiosoma laciniata* (Col. Not. III, p. 64), and *Tonibiastes* has for its type *Notibius costipennis* Horn, recently described from Lower California (Col. Baja Cal., p. 430). The other genera are separately alluded to below.

The scheme of classification originally followed and more recently maintained by Dr. Horn for this tribe, can scarcely be regarded as coming within the domain of scientific taxonomy and will ultimately have to be discarded.

### CONIBIUS Lec.

The species of this genus can be assigned to three subgenera, which are widely distinct among themselves in point of general appearance, as follows :—

|   |            |
|---|------------|
| Head parallel at the sides near the base; basal angles of the prothorax not rounded and nearly right.                                       |            |
| Body parallel, the elytra subequal in width to the prothorax.....   | <b>I</b>   |
| Body oval the elytra inflated and much wider.....   | <b>II</b>  |
| Head prominent at the sides before the eyes; body stout, parallel and oblong; basal angles of the prothorax obtuse and bluntly rounded..... | <b>III</b> |

The species are moderately numerous and those known to me may be readily identified by the following characters:—

Subgenus I.

**Conibius** Lec.

Humeral angles of the elytra more or less distinctly prominent.

Body narrow and elongate; pronotum densely punctate...**parallelus** Lec.

Body less slender, the elytra more deflexed and vertical at apex

Bicolored, the pronotum sparsely punctured toward the middle.

**seriatus** Lec.

Unicolorous, the pronotum more coarsely and densely punctured; body nearly twice as large.....**guadalupensis** Csy.

Humeral angles rounded or at least obtuse.

Antennæ moderately long; prothorax nearly one-half wider than long and very feebly narrowed toward base.....**uniformis** Csy.

Antennæ shorter; prothorax much more transverse, four-fifths wider than long, strongly narrowed toward base, the side margins narrowly sub-explanate.....**brunnipes** Champ.

Subgenus II.

**Ooconibius** n. sg.

Elytra oval, the lateral edges visible throughout from above and finely reflexed, more noticeably so near the base and toward apex.....**opacus** Lec.

Subgenus III.

**Euconibius** n. sg.

Pronotum broadly subexplanate toward the sides; fine side margins of the elytra visible throughout from above as usual but not reflexed.

**gagates** Horn

*Notibius reflexus*, recently described by Dr. Horn from Lower California (Col. Baja Cal., p. 429), cannot be distinguished from *opacus* by any detail given in the original diagnosis.

**NOCIBIOTES** n. gen.

The species of this genus have a characteristic facies, which will render their identification tolerably certain. The six representatives known to me may be recognized by the following table:—

Basal angles of the prothorax rather broadly oblique at the base, large and posteriorly prominent; pronotum more obscurely sculptured, the sides less rounded.

Third antennal joint fully twice as long as wide.

Elytral sulci deep; legs rather slender.

Pronotum somewhat coarsely and very closely punctured.

**granulatus** Lec.

Pronotum finely and much less densely punctured; body small, the base of the prothorax strongly bisinuate.....**gracilis** n. sp.

Elytral sulci shallow; body broader, the legs very stout; pronotal punctures much finer than in *granulatus* and rather well separated, the interspaces dull.....**crassipes** Csy.

Third antennal joint distinctly less than twice as long as wide; pronotal punctures rather coarse but somewhat separated, the basal angles very acute.....**acutus** n. sp.

Basal angles small and only feebly prominent posteriorly, the disk much more finely, deeply, sparsely and distinctly punctured, less transverse and more rounded at the sides.

Elytra in the female individually produced at apex, forming two processes separated by a narrow deep incisure; antennæ long.

**caudatus** n. sp.

Elytra not produced at apex, the antennæ much shorter...**rubripes** n. sp.

In the first group the form of the body is nearly parallel, with the elytra subequal in width to the prothorax, while in the second section the elytra are distinctly wider and are suboval in form.

As far as known, this genus is confined to the arid regions of southern California and Arizona.

**N. gracilis.**—Somewhat narrow, moderately convex, dull, black, the under surface rufo-piceous anteriorly; head rufescent toward apex; labrum, antennæ and legs brownish-rufous; surface virtually glabrous, the elytra with minute stiff inclined setæ toward the sides. *Head* three-fourths as wide as the prothorax, scabro-punctate, deeply sinuate at the middle of the clypeal margin; antennæ scarcely as long as the head and prothorax, the second joint quadrate, third rather more than twice as long as wide, fourth distinctly elongate, five to eight equal, quadrate, nine to eleven abruptly much wider, forming a parallel three-jointed club, the tenth moderately transverse, the eleventh rounded and only just visibly narrower. *Prothorax* about one-third wider than long, widest before the middle, the sides feebly arcuate, becoming convergent and perfectly straight toward base; apex broadly, circularly sinuate, the angles obtusely rounded; base transverse, subequal to the apex, strongly bisinuate, the angles posteriorly acute and prominent; disk rather indistinctly punctate, impressed at the posterior margin along the sinuations, not at all explanate laterally, the punctures elongate-oval, shallow, distinctly separated, well defined along their anterior margins, the posterior more indefinite, becoming larger and more isolated toward base; interspaces finely, evenly and strongly granulato-reticulate. *Elytra* scarcely one-half longer than wide, twice as long as the prothorax and subequal in width, the sides broadly arcuate, the apex gradually acutely ogival; sulci deep, with moderately distant shallow punctures, the convex intervals asperulate. *Abdomen* finely, sparsely punctate, the propleuræ with short sparse longitudinal cariniform elevations; legs moderate in length, the femora stout and inflated toward tip, the tibiæ slender. Length 3.8 mm.; width 1.3 mm.

California (Indio). Mr. Wickham.

Allied to *granulatus* Lec., but very much smaller, with much finer and feebler pronotal sculpture and more deeply bisinuate pronotal base, much more finely and sparsely sculptured propleuræ and several other characters. It is described from the female, and has been compared with the corresponding sex of *granulatus*.

**N. acutus.**—Moderately stout and convex, somewhat dull, black; head and edges of the pronotum rufescent; antennæ and legs brownish-rufous; integuments subglabrous. *Head* three-fourths as wide as the prothorax, nearly one-half wider than long, the sides parallel, rather abruptly and strongly convergent before the middle, the apical margin moderately sinuate in the middle; surface somewhat coarsely, densely scabro-punctate, more sparsely granose toward apex; antennæ a little shorter than the head and prothorax, the third joint distinctly less than twice as long as wide and shorter than the next two combined, fourth distinctly elongate, five to eight slightly decreasing in length, the former quadrate, the latter wider than long, club abrupt, the eleventh joint much narrower than the tenth. *Prothorax* two-fifths wider than long, widest before the middle, the sides very feebly arcuate, becoming straight posteriorly, the apex extremely feebly sinuate in circular arc, almost truncate, the angles broadly obtuse and rounded; base equal to the apex, transverse and feebly arcuate, becoming perceptibly sinuate near the angles, which are acute and prominent but scarcely projecting posteriorly beyond the median parts; disk rather coarsely, somewhat deeply and conspicuously punctate, the punctures oval, well separated and distinctly defined, each bearing a very short decumbent hair; interspaces rather smooth and alutaceous, obscurely granulato-reticulate. *Elytra* about one-half longer than wide, twice as long as the prothorax and scarcely wider, the sides parallel and feebly arcuate; apex conjointly acutely ogival; sulci deep and rather closely punctate, the intervals dull, densely granulato-reticulate and sparsely asperate. *Abdomen* sparsely punctate, the propleuræ moderately coarsely and densely scabrous. Length 4.0 mm.; width 1.45 mm.

Arizona.

The type is a male, having the anterior tibiæ rather stout, bent inward at apex and feebly prominent on the inner margin just behind the middle, the abdomen feebly impressed, more coarsely and closely punctate and more noticeably pubescent in the middle toward base, and the fifth segment broadly, feebly impressed.

This species differs from *granulatus* principally in its shorter form, much shorter and stouter anterior tibiæ in the male, coarser, sparser and more distinct pronotal punctures, and in its decidedly shorter third and narrower eleventh antennal joints.

**N. caudatus.**—Elongate-suboval, strongly convex, somewhat shining but alutaceous, black; legs dark rufous, the antennæ rufo-piceous; integuments subglabrous, the pronotal punctures bearing minute decumbent hairs and the elytral asperities bearing much inclined coarse setæ, which are quite distinct toward the sides. *Head* scarcely two-thirds as wide as the prothorax, slightly transverse, with rather small, deep, distinct and separated punctures, the apical emargination broad and subangulate; antennæ long, fully as long as the head and prothorax, the third joint much more than twice as long as wide and rather longer than the next two, club only slightly abrupt, the penultimate joints nearly as long as wide, the eleventh not narrower. *Prothorax* feebly transverse, barely two-fifths wider than long, widest somewhat before the middle but with the sides evenly and feebly arcuate throughout, not becoming straight posteriorly, just visibly sinuate for a very short distance before the basal angles which are right, not rounded and scarcely at all posteriorly prominent, the base transverse, becoming very feebly sinuate near the basal angles; apex quite distinctly narrower than the base, very evenly emarginate in circular arc, the angles distinct and only slightly blunt; disk evenly smooth and convex, finely, deeply evenly and somewhat sparsely punctate, the punctures becoming gradually a little coarser, denser and less defined toward the sides; interspaces shining. *Elytra* fully three-fifths longer than wide, more than twice as long as the prothorax, and, in the middle, one-fourth wider; sides evenly arcuate; humeri broadly rounded, not exposed; apex acutely and gradually ogival, each elytron produced in a short punctate and pubescent caudal appendage; sulci deep, punctate, the intervals each with a single even series of coarse asperities. *Abdomen* convex, shining, distinctly but sparsely punctate, the propleuræ longitudinally rugose; legs rather long, the femora only feebly inflated toward apex. Length 5.8 mm.; width 1.9 mm.

Arizona.

The type of this distinct species is a female, the anterior tibiæ and abdomen being unmodified, the fifth segment of the latter nearly flat and almost semi-circular.

**N. rubripes.**—Moderately slender and convex, strongly alutaceous, black, the head rufescent anteriorly; antennæ infusate in the middle; legs rufous throughout; integuments subglabrous. *Head* fully two-thirds as wide as the prothorax, broadly, angularly emarginate at apex, densely punctate; antennæ not as long as the head and prothorax, the third joint about twice as long as wide, the club but slightly abrupt, the tenth joint distinctly transverse. *Prothorax* nearly as in *caudatus*, the punctures slightly coarser and distinctly denser. *Elytra* scarcely more than one-half longer than wide, twice as long as the prothorax and nearly one-fourth wider, otherwise as in *caudatus*, except that the apices are not at all produced posteriorly. *Abdomen* strongly but not very closely punctate. Length 4.5 mm.; width 1.7 mm.

Arizona. Mr. Wickham.

The type of this species is also a female, and is very closely



allied to *caudatus*, differing in the shorter, non-caudate elytra, denser punctures of the head and pronotum, coarser abdominal punctuation, shorter antennæ and smaller size. The type is from a locality in Arizona, widely different from that of *caudatus*, and there is reason to believe that the caudal process in the latter is as permanent and invariable a feature as in *Eleodes caudifera* Lec.; so there appears to be but little doubt of the validity of the species.

#### TONIBIUS n. gen.

The only species which can be referred to this genus for the present are *sulcatus* Lec., and *alternatus* Csy. The latter of these species is in no sense an abnormal state of the former, of which I have before me an ample series, no specimen of which displays any tendency to vary in the direction of the peculiar specific characters of *alternatus*. In *alternatus* the size is materially greater than is ever attained by *sulcatus*, and the sculpture of the pronotum is very much coarser.

#### NOTIBIUS Lec.

This is a natural and distinctly characterized group of species, in which the body is stout, oblong and convex, with a dense decumbent fringe along the lateral margins of the prothorax, and broad fossorial anterior tibiæ in both sexes. The four species may be distinguished at once by the following strongly marked and constant characters:—

Third antennal joint elongate, gradually and feebly obconical from base to apex.

Sides of the pronotum broadly reflexo-explanate.....**puberulus** Lec.

Sides not at all or very narrowly subexplanate.

Head parallel at base; apical angles of the prothorax obtuse but evident externally; pronotum coarsely and deeply punctate.

**substriatus** Csy.

Head subangularly prominent at base; apical angles of the prothorax very broadly and transversely rounded; pronotum very finely, feebly and sparsely punctate.....**laticeps** Csy.

Third antennal joint short, only slightly longer than wide and dilated at apex.

**puncticollis** Lec.

Of *substriatus* I have a large series, taken by Mr. Weidt in southwestern Utah; it extends thence to the elevated plains of the Mojave Desert in California. *Puberulus* is represented in

my cabinet by two perfectly similar specimens from the less elevated desert regions of the extreme southern part of California, whence it was originally described, and *laticeps* by four homogeneous examples. *Puncticollis* is more northern in its range in California.

#### BOLITOPHAGINI.

The North American genera of this tribe seem to be more conveniently divisible into primary groups upon the basis of antennal structure than by the structure of the eyes, and, the occurrence of an interesting new type in the Pacific coast region, affords an opportunity to outline their distinguishing characters as follows :—

Antennæ 10-jointed, the third much elongated, tenth perfectly free, the ninth not emarginate; eyes not divided; prothorax broadly pedunculate at base.

#### **Bolitotherus**

Antennæ 11-jointed.

Eleventh joint free, the tenth broadly arcuato-truncate at apex; eyes completely divided.

Pronotum tuberculose; elytra with coarse interrupted ridges.

#### **Bolitophagus**

Pronotum punctate; elytra with fine continuous ridges.....**Eleates**

Eleventh joint set partially within the emarginate apex of the tenth and in close contact throughout the width; eyes not divided.

Mentum not carinate; elytra with series of tubercles.....**Megeleates**

Mentum with a strong compressed keel; elytra with fine even ridges.

#### **Eledona**

Eledona appears to be of doubtful occurrence in the United States, but is introduced for comparison.

#### **MEGELEATES** n. gen.

Body thick, subcylindric. Head deeply inserted, the apical margin not reflexed except feebly toward the sides, continuously and evenly arcuate, obtusely prominent laterally before the eyes, the latter moderately coarsely faceted and one-half divided. Maxillary palpi subcylindric in form, the joints in close mutual contact, polished and sparsely punctulate, the last cylindro-conical and nearly twice as long as the third. Antennal grooves beneath the eyes moderately deep. Antennæ with the third joint only slightly elongate. Prothorax not in the least pedunculate at base. Scutellum oval, truncate at base. Epipleuræ horizontal, rather

wide and of almost equal width from the base to within a short distance of the apical angles, where they become rapidly narrowed. Anterior coxæ moderately separated, the intermediate more widely, the process of the mesosternum slightly tumid and anteriorly excavated to receive the prosternal process; posterior separated by two-thirds of the coxal width, the abdominal process broadly rounded. Met-episterna narrow and parallel. Legs short and stout; tibiæ tricarinate externally; tarsi thick, the last joint of the posterior as long as the preceding three.

**M. sequoiarum** n. sp.—Oblong, strongly convex, opaque throughout, black and glabrous. *Head* not coarsely but strongly scabro-punctate, with a tuberculiform elevation above each eye; antennæ as long as the width of the head, the three outer joints broader and minutely, densely pubescent, joints before the club triangular, ninth and tenth strongly transverse. *Prothorax* fully twice as wide as long, twice as wide as the head, the apex three-fourths as wide as the base; sides evenly arcuate throughout and strongly crenulate; apical angles advanced; base arcuate, becoming obliquely sinuate toward the sides; disk rather abruptly and broadly reflexed toward the sides, covered with coarse separated tubercles, sulcate along the middle, the sides of the sulcus becoming carinate anteriorly in the male but simply tumid in the female. *Elytra* parallel, subequal in width to the prothorax, about two-fifths longer than wide, broadly but evenly rounded at apex; side margins slightly prominent, more so and cariniform toward apex, strongly crenulate, not at all reflexed; disk vertical at the sides, having regular series of rather coarse, close-set, opaque tubercles, the intervals each with a series of coarse and rounded punctures separated by small tubercles; third, fifth and seventh series of tubercles more prominent, the third especially so toward the summit of the apical declivity, which is almost vertical in profile. *Abdomen* strongly and closely punctate, the legs less coarsely, strongly and very densely punctate. Length 6.5–7.0 mm.; width 3.4–3.6 mm.

California (Big Trees, Calaveras Co.). Dr. Blaisdell.

The sexual differences are very feeble, the male having the sides of the pronotal sulcus more prominent and laminate toward apex, as stated, and the general form of the body sensibly shorter. Several specimens.

#### ANTHICIDÆ.

The following studies were undertaken largely for the purpose of identifying and naming a considerable number of nondescripts, which have been accumulating for many years, but, at the same time I have become much interested in the general grouping and classification of the genera, points which were left in a very un-

satisfactory state by LeConte and Horn, the very important and obvious abdominal structure of the Xylophilinæ, for example, being completely overlooked by these usually acute observers. The last revision of the American species, as a whole, was published by LeConte more than forty years ago, and is at present of course very incomplete.

The sexual characters of the abdomen are in some groups very pronounced and in others feeble, differing greatly in general character in the various genera and usually varying distinctly in degree from species to species. In the Eurygeniini the external modifications are conspicuous only in Retocomus, and in that tribe the intromittent organ is of a somewhat simple type throughout. In Pedilus (=Corphyra) and Macratiria, genera with distinct tarsal modifications, the external characters are feeble, while the intromittent apparatus becomes marvelously complex. These facts tend to prove still further that primary sexual characters, when differing distinctly in type, may in certain cases be quite as valuable in defining genera as any other structural modification.

The well known scarcity of individuals in many parts of the series, as for instance in the Eurygeniini and Xylophilinæ, results in all probability, chiefly from the fact that we do not know the habits of these insects, which are very different from the epigeal Anthicini. It is possible that each species may appear in abundance only at certain very limited seasons or on certain individual trees, as is known to be the case with a number of longicorn groups of supposed excessive rarity.

The Anthicidæ may be divided into two important subfamilies as follows:—

Abdomen composed of five free segments; tarsus with the penultimate joint lobed beneath; tibial spurs generally distinct; labial palpi minute.

#### ANTHICINÆ

Abdomen composed of four free segments, the first formed of two amalgamated somites with the suture sometimes indicated; tarsus with the antepenultimate joint lobed beneath, the penultimate small; tibial spurs generally obsolete; labial palpi with the last joint large and more or less dilated.

#### XYLOPHILINÆ

#### ANTHICINÆ.

This subfamily may be divided into five tribes by the following characters:—

Tarsal claws appendiculate; eyes emarginate and finely faceted; neck wide; maxillary palpi slender.....NEMATOPLINI

Tarsal claws not appendiculate.

Neck wide; eyes large, finely faceted and generally emarginate; basal segment of the abdomen not elongate.

Prothorax constricted at apex and margined at base; tarsal claws simple or with a feeble dentiform dilatation at base.....EURYGENIINI

Prothorax not constricted at apex, margined at base; tarsal claws with a pointed lamelliform tooth internally at base, the apical part abruptly bent.....PEDILINI

Neck narrow; eyes not emarginate; prothorax constricted at apex.

Eyes large, oval, rather finely faceted; basal segment of the abdomen elongate; claws somewhat as in Pedilini.....MACRATRIINI

Eyes small, rounded, not emarginate, generally coarsely faceted; basal segment of the abdomen not conspicuously elongate; claws simple.

ANTHICINI

The first four of these tribes are arboreal in habit, the fifth epigeal. The *Xylophilinæ* are arboreal, and it might therefore be considered best to put them at the head of the family, instead of immediately succeeding the Anthicini; but it will be observed that the *Xylophilinæ* differ quite as much, if not more, from the *Eurygeniini* as from the *Anthicini*, and it is therefore immaterial where we place them. Again, the apical constriction of the prothorax, which is such a constant and peculiar feature of the *Anthicini*, is even more strongly developed in the *Eurygeniini*, and is altogether obsolete in *Xylophilinæ*; the eyes are finely faceted in all the larger forms constituting the first tribes, coarsely so in *Anthicini* and generally very coarsely so in *Xylophilinæ*; so, considering the question from all points of view and having due regard to the small size and less highly developed structure, as shown by the amalgamated basal segments of the abdomen, it seems more fitting to place the subfamily at the end of the series.

Concerning the erection of a distinct family for the *Xylophilinæ*, as proposed by Mr. Champion, I regret to have to disagree. The sclerites of the under surface, especially near and between the middle coxæ, are identical in *Anthicus* and *Xylophilus*, except that the mesosternal process in the latter is not quite so long, and there is, besides, a certain indefinable habitus possessed by the two types in common, which seems to show that they should not be widely separated.

## NEMATOPLINI.

The exceedingly rare *Nematoplus collaris* Lec., is at present the only species assignable to this tribe. The hind tarsi are filiform throughout, with the third joint simple and cylindrical; this very exceptional structure in the first genus of the subfamily being similar to that of *Mecynotarsus*, which I have placed at the end. The tarsal claws are by no means cleft, as stated by LeConte and Horn (Class. Col. N. A., p. 410), but are simple and thickened or subdentate internally at base, where there is attached a long slender minutely pubescent appendage, which almost equals the claw in length; besides this remarkable appendage, there is a distinct bisetose onychium between the claws.\* The last antennal joint is not unusually elongate, and the feeble apical constriction of the prothorax does not extend laterally upon the flanks.

## EURYGENIINI.

The genera composing this tribe are somewhat numerous, and are confined entirely to the new world; those known to me at present may be distinguished as follows:—

Last joint of the antennæ not noticeably elongate.

Eyes narrowly and distinctly emarginate.

Tempora prominent; antennæ filiform; maxillary palpi large, with the last joint triangular.....**Retocomus**

Tempora not prominent; antennæ serrate and very long; maxillary palpi small, filiform, the last joint cylindrical and not much longer than the preceding.....**Mastoremus**

Eyes truncate or broadly and feebly sinuate; antennæ filiform.

Tempora well developed and prominent.

Eyes large; spurs of the hind tibiæ short; last joint of the maxillary palpi long and cultriform.....**Stereopalpus**

Eyes much smaller; spurs of the hind tibiæ long; maxillary palpi greatly developed, very broad, the joints triangular.....**Pergetus**

Tempora not prominent; eyes very large; tibial spurs short.

**Eurygenius**

Last joint of the antennæ much elongated.....**Bactrocerus**

These genera are all North American, except *Eurygenius*, which is confined as far as known to Brazil. The third joint of the hind tarsi is triangular, not dilated and not membranous or

\* The claws were described properly by LeConte in the original diagnosis of *Nematoplus* (Proc. Ac. Nat. Sci., Phila., 1855, p. 275).

noticeably produced beneath. *Bactrocera* contains a single species from Lower California, which I do not have before me at present; the pronotum is covered with coarse sparse and crescentiform granulations, and has the vestiture coarse and sparse.

**RETOCOMUS** n. gen.

The North American species hitherto regarded as *Eurygenius*, differ so greatly from the South American type as defined by La-Ferté, that it seems impossible to avoid defining a distinct genus to receive them, and for this the above name is suggested. In the type of *Eurygenius* the eyes are not emarginate and the tempora are not at all prominent, besides many other differences, notably in the organs of the mouth. LeConte and Horn state that in *Eurygenius murinus*—which is the only species which I have not been able to examine,—the eyes are practically not emarginate; this species seems also, from the original description of LeConte, to depart markedly in vestiture from the others, and future study may possibly prove it to be generically distinct; it occurs in Georgia and Alabama. In all the other representatives the emargination of the eyes is deep and distinct, not essentially differing in *constrictus*.

Our species may be defined as follows:—

Elytra each with five narrow vittæ of fulvous pubescence.....**wildi** Lec.

Elytra with uniformly colored pubescence, which is uneven in distribution.

Species of the Atlantic region.....**murinus** Hald.

Species of the Pacific coast.

Prothorax with a strongly developed arcuate apical lobe and a deep broad constriction; elytra vaguely subvittate.....**constrictus** Lec.

Prothorax with a smaller apical lobe and finer constriction; elytra unevenly and sparsely marmorate with condensed white pubescence, not at all subvittate.

Abdomen clothed with long shaggy pubescence, the elytra about twice as long as wide.....**gratus** n. sp.

Abdomen clothed with much shorter, more recumbent pubescence; elytra distinctly more than twice as long as wide.

**decurellus** n. sp.

The two sexes of *wildi* seem to differ a good deal in general form, the male being smaller, more slender and with subcuneiform elytra; in the female the elytra are broad and parallel.

All the species which I have examined have the basal joint of the hind tarsi strongly contorted at base, a character which is

purely asexual, and scarcely at all developed in the genera of this tribe which have unemarginate eyes. In *Mastoremus*, which also has emarginate eyes, it is very noticeable, and there may possibly be some correlation between these characters.

**R. gratus.**—Rather narrow, black, the femora and tibiae toward base slightly rufescent, sparsely clothed with complex pubescence, consisting of almost evenly distributed suberect short gray hairs, widely scattered long erect black setae, and decumbent coarse white hairs in uneven widely scattered spots on the elytra. *Head* as wide as the prothorax, about as long as wide, the eyes large and prominent, separated by but slightly more than their own width on the front, the latter coarsely, densely punctate and coarsely shaggy; antennae slender, moderate in length; palpi moderate. *Prothorax* as long as wide, rounded on the sides at apical third, thence feebly convergent and broadly, evenly sinuate to the base; apical constriction fine, extending across the dorsal surface; apical lobe short, three-fifths as wide as the base; disk not canaliculate, not very coarsely, densely punctate and dull, the punctures longitudinally coalescent. Scutellum clothed with white hair. *Elytra* scarcely more than twice as long as wide, fully three-fourths wider than the the prothorax and rather more than three times as long; sides subparallel and nearly straight to apical fifth, then almost evenly rounded, finely dehiscent toward apex, the sutural angles right; disk polished, coarsely, deeply punctate, the punctures separated by about their own diameters. Under surface shining, moderately closely punctate and clothed with long hair, quite sparsely on the abdomen. *Legs* moderate, the femora gradually stout; tibiae roughly asperate externally; hind tarsi fully three-fourths as long as the tibiae, with the basal joint strongly contorted at base and much longer than the fourth. Length 8.4 mm.; width 2.2 mm.

California (Sta. Cruz Co.)

The two specimens are perfectly similar males, having the fifth ventral deeply excavated in the middle throughout the length, the sides of the excavation prominent and lamellate posteriorly.

**R. decorellus.**—Moderately slender and convex, black, the tibiae, except at base and apex, and the basal parts of the femora feebly suffused with rufous; elytra with a feeble violaceo-æneous metallic lustre; vestiture nearly as in *gratus* but still somewhat sparser, the elytral spots rather more numerous and more evenly scattered. *Head* densely punctate and dull, the eyes large and prominent, separated on the front by quite distinctly more than their own width; antennae slender, filiform, the basal joint stoutest, but little longer than the head and prothorax. *Prothorax* noticeably longer than wide, rounded on the sides anteriorly, subparallel and broadly, feebly sinuate thence to the base, the apical node short, nearly two-thirds as wide as the base; disk dull, moderately coarsely, deeply, longitudinally punctato-rugose, the sculpture but little concealed by the vestiture. Scutellum clothed as usual with white pubescence. *Elytra* almost twice as wide as the prothorax and much



more than three times as long, about two and one-half times as long as wide, polished, coarsely, deeply punctate nearly as in *gratus*. Under surface sparsely hairy, the legs moderately stout, the basal joint of the hind tarsi but slightly longer than the last. Length 8.8 mm.; width 2.4 mm.

California (Marin Co.).

The single male before me represents a species allied rather closely to *gratus*, but differing in a number of well marked structural characters. The elytra are more elongate and more finely pubescent than in *gratus*, and, although the large deep excavation of the fifth segment is nearly similar, the copulatory spicule differs decidedly, being much stouter, with a broad dorsal impression extending only slightly beyond the middle of its length; in *gratus* it is more attenuate, with the dorsal channel fine, extending almost to the extreme tip and gradually disappearing.

#### **MASTOREMUS** n. gen.

Body subcylindrical. Head rather narrower than the prothorax, feebly but abruptly constricted at base, the neck relatively long and thick; tempora convergent and arcuate behind the eyes, long but not at all prominent; eyes large, deeply emarginate, finely granulated; antennae in the male nearly as long as the body, the joints longer than wide, serrate within, gradually longer, narrower and less serrate from the sixth, the second joint minute, globular; maxillary palpi slender, moderate in size, joints equal in thickness, slender, obconical, the last cylindrical, obtusely pointed and obliquely truncate at apex and but slightly longer than the third; labial palpi minute, apparently two-jointed. Epistomal suture subobsolete. Prothorax constricted at apex, the basal margin fine but defined throughout by an impressed line. Scutellum moderate, broadly rounded behind. Elytra coarsely, confusedly punctate, elongate. Abdomen with five free equal segments. Metasternum long. Middle coxae slightly separated. Legs moderate in length, rather thick, clothed with long coarse sparse and erect hairs, the tibial spurs short but slender, simple; hind tarsi slender, filiform, clothed with short stiff blackish hairs, the third joint not wider, triangular, longer than wide, the first contorted at base and slightly longer than the fourth; claws well developed, thickened within toward base.

The single species upon which I have been compelled to found a distinct genus, differs markedly in type from any other known

member of the Eurygeniini, especially in the structure of the antennæ and palpi and basal parts of the head.

**M. longicornis** n. sp.—Narrow, convex, polished, black, the elytra, mandibles except at tip, and the base of the first hind tarsal joint rufo-testaceous; vestiture rather sparse, coarse, not at all concealing the surface sculpture and only slightly and indefinitely irregular on the elytra, yellowish-cinereous in color. *Head* as long as wide, suboval, rather convex, somewhat coarsely, not densely punctate; basal constriction feeble, slightly arcuate; neck very long dorsally, fully two-thirds as wide as the head; eyes separated by about twice their own width; tempora convergent behind them and about three-fifths as long; mandibles prominent; antennæ nearly as long as the body, opaque black and, excepting the two basal joints, clothed with short dense stiff pubescence throughout, two basal joints shining, sparsely setose. *Prothorax* rather wider than the head, fully as long as wide, the sides feebly convergent and broadly arcuate from the middle to the strong apical constriction, rather abruptly narrowed at the middle, the sides thence feebly oblique and sinuate to the base; disk convex, not coarsely, feebly, unevenly and sparsely punctate, the canaliculation fine but distinct, broadly, feebly impressed. *Elytra* three-fourths wider than the prothorax, slightly more than twice as long as wide, the sides parallel and straight, obtusely rounded in apical fifth; humeri transversely rounded to the prothorax; punctures very coarse, deep, the interspaces about as wide as the punctures, not punctulate. *Abdomen* feebly and sparsely punctate, coarsely and sparsely pubescent. Length 6.0 mm.; width 1.6 mm.

Arizona (Pinal Mts.). Mr. H. F. Wickham.

The unique type is a male, having very feeble abdominal characters, the copulatory spicule sagittiform as in *Retocomus* and other genera of the tribe. This form is absolutely different from that seen in *Pedilus* and *Macratria*.

### **STEREOPALPUS** Laf.

This well known genus is somewhat rich in species, occurring throughout the United States; I have separated the eleven known to me as follows:—

Vestiture uniform in distribution and in general tint.

Head equal in width to the prothorax.

Species of the Atlantic regions; pronotal sculpture finer and less dense, the elytral punctures coarser and more distinct.

Elytra generally concolorous, though often a little paler; median stria-form sulcus of the pronotum usually distinct at least near the base.

**mellyi** Laf.

Elytra always paler, rufous; integuments thicker, the pronotal stria generally subobsolete, though occasionally quite readily traceable (*badiipennis* Lec.) ..... **vestitus** Say

Species of the Pacific coast regions.

Femora pale rufous, the extreme apex alone abruptly blackish.

Body slender, the vestiture less dense, the semi-erect hairs brownish.....**pruinus** Lec.

Body stout, more densely pubescent, all the hairs whitish.

**incanus** n. sp.

Femora black, slightly rufescent at base; tibiae pale rufous.

**variipes** n. sp.

Femora and tibiae black throughout.....**indutus** n. sp.

Head much smaller and narrower than the prothorax; body large and stout, the vestiture very dense throughout.....**nimius** n. sp.

Vestiture of the elytra not uniform in distribution.

Elytra closely and finely mottled with small irregular clusters of only slightly greater density; legs testaceous throughout.....**rufipes** n. sp.

Elytra more sparsely variegated with large spots of more condensed white pubescence.

Legs completely black throughout.

Pronotum scarcely at all impressed laterally. Wyoming to Oregon.

**guttatus** Lec.

Pronotum strongly impressed in the middle toward the sides.

**impressicollis** n. sp.

Legs rufous, the femora black except at base.....**subalbicans** n. sp.

There can be no doubt whatever of the identity of *Edemera vestita* Say (Journ. Ac. Nat. Sci., Phila., III, 1823, p. 273) with *S. badiipennis* Lec., and the species is closely allied to *mellyi* Laf., though probably distinct. It is possible that *Eurygenius murinus* may be better placed in the present genus, but a renewed inspection of the palpi would be necessary to decide.

The species of *Stereopalpus* are very uniform in structure throughout, and have comparatively feeble sexual characters; the male has a small terminal and densely punctate genital segment, which is but little protruded. The eyes are broadly and feebly sinuate anteriorly.

**S. incanus.**—Slightly stout, black, densely clothed with stiff white pubescence which, on the elytra, does not quite conceal the surface lustre, and which as usual there consists of short semi-erect sparser hairs mingled with recumbent pubescence. Head finely, densely rugoso-punctate and dull; eyes convex, prominent, separated by twice their own width, narrowly rounded beneath, broadly above, obliquely truncate behind and surrounded, especially behind, by a fine polished glabrous line; antennae black, the basal joint rufescent, slightly longer than the head and prothorax combined; clypeus twice as wide as long, rectangular and transversely truncate, not differing in sculpture. Prothorax sculptured like the head, rather longer than wide, rounded on the sides anteriorly, thence just perceptibly narrowed and broadly, distinctly sinuate

at the sides to the base; apical constriction fine, deep, entire, the lobe short, two-thirds as wide as the base; canaliculation barely traceable; lateral impressions feeble. *Elytra* scarcely more than twice as long as wide, more than twice as wide as the prothorax, parabolic in apical fourth; sides parallel; impression within the humeri feeble; humeri obliquely truncate at base; disk moderately strongly punctate, with the interspaces finely punctulate. *Abdomen* finely, densely punctate and pubescent; legs rather slender. Length 6.3 mm.; width 1.9 mm.

California (Los Angeles Co.).

The type appears to be a male. *Incanus* is related to *pruinus*, but differs in its more obese form and much denser vestiture.

**S. variipes.**—Rather slender and convex, black, the elytra shining, without any kind of metallic lustre; pubescence rather sparse, not concealing the surface sculpture even on the anterior parts. *Head* not coarsely but very densely rugoso-punctate, much wider than long, the eyes separated by about twice their own width; tempora large, rather more prominent than the eyes and three-fourths as long; antennæ very slender, much longer than the head and prothorax together, the basal joint not paler. *Prothorax* sculptured like the head, not quite as long as wide, strongly rounded at the sides anteriorly, thence deeply sinuate to the base, which is but slightly narrower than the maximum width; apical constriction evident, the lobe short; canaliculation fine, very distinct; lateral impressions distinct but situated on the extreme flanks. *Elytra* distinctly more than twice as long as wide, barely twice as wide as the prothorax, parabolic in apical fourth; sides parallel; humeri broadly, obliquely rounded at base; punctures moderately coarse, deep, separated by about their own widths. Under surface minutely, densely punctate and pubescent. Length 8.0 mm.; width 2.0 mm.

California (Yreka, Siskiyou Co.).

Allied only to *indutus*, but differing in its larger size, heavier prothorax with much stronger median sulcus, differently colored legs, larger tempora and several other features; it is represented by a single specimen of undetermined sex.

**S. indutus.**—Moderately slender and convex, black throughout, the polished lustre of the elytra feebly appearing through the close even vestiture of cinereous tint. *Head* slightly transverse, densely, not coarsely rugoso-punctate and dull; eyes large, separated by twice their own width on the front; tempora one-half as long as the eye; antennæ slender, much longer than the head and prothorax combined. *Prothorax* about as long as wide, sculptured like the head, rounded on the sides anteriorly, sinuate posteriorly, the base dilated as usual and but slightly narrower than the anterior parts of the disk; apical constriction fine, entire; canaliculation fine or subobsolete; lateral impressions distinct and extending obliquely on the disk. *Elytra* twice as wide

as the prothorax and a little more than twice as long as wide, parabolic in apical fourth; sides parallel; humeri evenly rounded to the prothorax, becoming transverse just before that limit; impression within the humeri just traceable; disk moderately coarsely punctate as usual, the shining interspaces finely punctate. Under surface finely densely and uniformly punctate and pubescent. Length 7.0 mm.; width 1.9 mm.

California (Hoopa Val., Humboldt Co.).

This species is represented by a single male, which has the fifth ventral segment broadly truncate at apex; it resembles *variipes* in general form, but differs in coloration, smaller size, relatively much smaller head and prothorax, the latter without a well marked median channel, denser vestiture and several other characters.

**S. nimius.**—Stout, convex, black throughout, the tibiae just visibly rufescent; elytra opaque, the surface scarcely at all visible through the dense cinereous vestiture which clothes every part of the body. *Head* small, distinctly shorter and narrower than the prothorax, almost as long as wide, densely opaque, the surface concealed; eyes separated by a little more than twice their own width on the front; tempora rather more prominent than the eyes and about two-thirds as long; antennae slender, but little longer than the head and prothorax, the stouter basal joint not paler. *Prothorax* slightly wider than long, sculptured and clothed like the head, rounded on the sides anteriorly, thence feebly, obliquely narrowed to the dilated basal margin; apical constriction fine but deep, the lobe crescentiform, rounded on its anterior margin though short; lateral impressions distinct; canaliculation narrow but very deep, appearing like a coarse crack. *Elytra* twice as wide as the prothorax, but slightly more than twice as long as wide, gradually narrowed and parabolically rounded behind in apical two-fifths; sutural angles rounded; humeri slightly rufescent, rounded to the prothorax, the humeral impression slight; disk with composite punctuation as usual, the interspaces shining but almost completely concealed except toward base. *Abdomen* extremely densely punctulate and pubescent. Legs normal. Length 11.5 mm.; width 3.3 mm.

Southern California.

The unique type of this very distinct form is probably a female; the dorsal pygidium is almost completely visible and porrect behind the elytra, and the fifth ventral is slightly longer than the fourth, narrowed behind, the apex rather narrowly truncate, the basal margin rufescent.

**S. rufipes.**—Rather slender, black, shining, the vestiture but slightly concealing the surface lustre; legs testaceous; pubescence stiff, yellowish-cinereous in color, feebly nucleated on the elytra. *Head* slightly wider than long, strongly, very densely and rugosely punctate; eyes large, globose, separated by one-half more than their own width, the tempora behind them much less prominent and only about one-third as long; antennae very slender, filiform,

fully two-fifths as long as the body, the basal joint not paler. *Prothorax* scarcely as wide as the head and not quite as long as wide, strongly but not very coarsely or densely granulato-punctate, the surface shining through the vestiture; sides strongly rounded anteriorly, thence distinctly convergent and feebly sinuate to the basal margin, which is not dilated; apical constriction distinct, the lobe extremely short; canaliculation fine but very deep and distinct; lateral oblique impressions feeble. *Elytra* twice as wide as the prothorax, distinctly more than twice as long as wide, parabolic in apical fourth; humeri transversely, broadly rounded to the prothorax, the intrahumeral impression short, basal and very distinct; disk strongly but only moderately coarsely punctate, giving a subrugose appearance, the interspaces not distinctly punctulate. Under surface finely, densely punctate and pubescent. Length 6.5-8.0 mm.; width 1.8-2.2 mm.

#### Indiana.

In its larger, more globose and less distant eyes, shorter, less prominent tempora and generally more shining surface, this species departs from the common type of the Pacific coast and approaches *mellyi*. It differs from *mellyi* in the small nuclei of pubescence scattered irregularly and indefinitely over the elytra, and in the smaller, more strongly and coarsely sculptured and more deeply canaliculate prothorax. Four specimens, with very feeble sexual characters.

**S. impressicollis.**—Black and moderately stout, the elytra shining through the vestiture, which is rather sparse except in the condensed spots; legs and antennæ black throughout. *Head* densely punctato-rugose and dull, the vestiture dense; eyes moderate, separated by distinctly more than twice their own width, the tempora fully as prominent as the eyes and about one-half as long; antennæ moderately slender, about two-fifths as long as the body. *Prothorax* as long as wide, rounded on the sides anteriorly, sinuate thence to the basal margin, which is scarcely dilated and defined throughout dorsally by a distinct groove; apical constriction fine, distinct; canaliculation fine, deep, impressed; lateral oblique impressions strong; sculpture rugose. *Elytra* slightly more than twice as wide as the prothorax, a little more than twice as long as wide, quite perceptibly wider to apical fourth, then parabolically rounded, narrowly and gradually dehiscent behind, the sutural angles obtusely rounded; humeri broadly, evenly rounded, the impression feeble; punctures coarse, close, the surface subrugose; interspaces shining and not distinctly punctulate. *Abdomen* minutely, extremely densely punctate and pubescent. Length 6.3 mm.; width 2.0 mm.

California (Hoopa Val., Humboldt Co.).

The single specimen is a female, and, if my memory serves, was taken very nearly or quite at the same time and place as the single male of *indutus*, so that for some time I considered them to be

the two sexes of one species. I find, however, that the spotted vestiture is a constant asexual character in other species, or at least is not at all characteristic of the female, and, besides this, these two specimens differ structurally to a considerable degree, the entire form of the body being different; finally, the deep median sulcus of *impressicollis* exists only as a vestige in *indutus*.

**S. subalbicans.**—Narrow, convex, the elytra polished, the lustre but little concealed by the scanty cinereous vestiture, except in the dense and widely scattered spots; color of body and antennae black throughout, the femora black, rufescent at base; tibiae rufous, the apex black; tarsi black, the basal joint feebly rufescent except toward apex. *Head* but slightly wider than long, relatively coarsely, very deeply and densely rugoso-punctate but not dull, the vestiture rather short and only moderately dense; eyes separated by a little more than twice their width, the tempora equally prominent and about one-half as long; antennae rather stout, filiform, distinctly less than one-half as long as the body. *Prothorax* barely as long as wide, with outline nearly as in the preceding species, sculptured almost like the head, the median sulcus strong, impressed; lateral impressions very feeble; surface unusually convex. *Elytra* evidently less than twice as wide as the prothorax and distinctly more than twice as long as wide, the sides parallel, parabolic in apical fourth, scarcely at all deliscent on the suture even at the extreme apex; humeri broadly rounded to the prothorax; punctures coarse, deep and close, the sculpture rugulose by anteriorly oblique light; interspaces not appreciably punctate. *Abdomen* closely punctate but unusually shining, the punctures smaller and more superficial. Legs rather long. Length 5.5 mm.; width 1.5 mm.

California (San Francisco). Mr. Dunn.

The smallest species of the genus and quite distinct from any other, differing from *impressicollis* in the feeble pronotal impressions and color of the legs, and from *guttatus* in its much smaller size and more slender form. The single specimen is a male.

#### **PERGETUS** n. gen.

This genus is founded upon *Eurygenius campanulatus* of LeConte, which occurs in the Island of Vancouver. As a genus it is remarkably distinct from *Retocomus* in the structure and vestiture of the legs, in the comparatively small, unemarginate eyes and much more developed maxillary palpi. The pronotum is deeply and peculiarly sulcate along the middle; the sexual characters affecting the fifth segment of the abdomen are feeble, and the tibial spurs are long, all of which characters are foreign to *Retocomus*. The tibiae are cylindrical, and are clothed with short stiff inclined pubescence, very uniformly throughout, while in *Reto-*

comus they are slightly irregular, strongly hispid externally, and clothed with long sparse flying hairs in addition to the more recumbent pubescence.

#### PEDILINI.

This tribe contains but one genus within our territories. *Pedilus* is said by Mr. Champion to be the same as *Corphyra* Say, and, if so, our numerous closely allied and prettily colored species will have to be called by that generic name. The third joint of the hind tarsi is produced beneath in a short membranous lobe. Our species of *Corphyra* have been recently reviewed by Dr. Horn (Tr. Am. Ent. Soc., 1871, p. 228, and l. c., 1883, X, p. 305).

The male intromittent organ in *Pedilus* is complex, the efferent duct lying in a *dorsal* excavation of the protective sheath, which is furnished with two internally barbed lateral appendages at apex. This structure is interesting when compared with the equally complex organ of *Malporus*, of the Anthicini, where, however, the efferent duct lies in an excavation on the *under surface* of the sheath, these extremely important conditions being completely reversed.

#### MACRATRIINI.

The following genus is the only one of this tribe which is known at present :—

#### **MACRATRIA** Newm.

The genus *Macratría* departs widely from all foregoing types of the Anthicinae in its very slender neck and elongated basal segment of the abdomen. The last three antennal joints are elongate and the third joint of the hind tarsi has a short membranous lobe beneath. In the structure of the *œdeagus* it differs radically in type from the Eurygeniini, but is to a great extent homologous with the Pedilini. The tibial spurs are rather remarkable in structure, being densely clothed with minute inclined setæ, the outer spur much stouter than the inner.

The four species represented in my cabinet may be thus defined :—

Last joint of the antennæ subequal in length to the two preceding combined in both sexes.

Head minutely and remotely punctate; legs dark in color...**confusa** Lec.



Head less minutely and very closely punctate; legs pale.

Elytra finely, densely sculptured and pubescent; prothorax more rapidly narrowed anteriorly than posteriorly.....**murina** Fab.

Elytra coarsely and much more rugosely sculptured, more coarsely and sparsely pubescent; prothorax equally oblique anteriorly and posteriorly, widest at the middle.....**ovicollis** n. sp.

Last joint of the antennæ but slightly longer than the penultimate; body red-brown throughout, the head more oblong.....**brunnea** n. sp.

Judging by the figure of *M. linearis* Newm., reproduced by La-Ferté, it seems impossible to associate it with any species of *Macratria* now known. If rediscovered it will probably prove to be the type of a distinct genus, which must be called *Macratria*, the species here tabulated to be then known as *Macrarthria* Er.

**M. ovicollis.**—Moderately slender, black, the legs, antennæ and palpi ochreo-testaceous, the femora feebly nubilate with brown near the apex and the ninth and tenth antennal joints darker toward base; pubescence moderately dense, yellowish, readily removable. *Head* as long as wide, broadly subtruncate at base, paler toward apex, the eyes separated on the front by rather less than twice their own width; antennæ about as long as the head and prothorax, filiform, the ninth and tenth joints subequal and each one-half longer than the eighth, second very nearly as long as the third. *Prothorax* two-fifths longer than wide, one-half longer and just visibly wider than the head, the sides evenly and strongly arcuate from apex to base, the base, immediately in advance of the basal depression, strongly rounded, rather more prominent than the basal bead and more feebly sculptured; disk feebly, evenly convex, very densely punctato-rugose. *Elytra* at base one-third wider than the prothorax, a little more than twice as long as wide, the sides straight and very feebly convergent from base to apex; disk rather shining when denuded, roughly and seriatly asperato-rugose, the intervals finely, densely punctato-rugose. Under surface minutely, densely punctate, the legs stout. Length 4.5 mm.; width 1.0 mm.

New York.

The male type has the fifth ventral not longer than the fourth, broadly, transversely truncate at apex and very broadly, feebly impressed on the disk almost throughout the width. I have for the present associated with the type two females which, however, have the prothorax widest at apical third.

**M. brunnea.**—Moderately stout, the male more slender, dark red-brown, the head paler, rufous, the antennæ, palpi, anterior and intermediate legs paler, ochraceous; hind legs piceous; sculpture throughout fine, very dense, the surface not shining; pubescence short, very dense, yellowish-cinereous in color. *Head* oblong-oval, as long as wide, finely, densely punctate, truncate at base; eyes separated by twice their own width; tempora strongly

rounded to the neck, one-half as long as the eye and much less prominent; antennæ about as long as the head and prothorax, slender and filiform, the last three joints much stouter, eighth much shorter than the seventh, second and third equal in length, the former slightly the thicker. *Prothorax* one-third to two-fifths longer than wide, subequal in width to the head, widest at apical two-fifths, finely, densely punctate and rugose, the surface even; basal margin strongly marked at the sides. *Elytra* one-third to nearly one-half wider than the prothorax, nearly two and one-half times longer than wide, slightly cuneiform, rather narrowly and conjointly rounded at tip; humeri strongly, evenly rounded to the prothorax; disk striato-punctate, the suture strongly margined. Under surface minutely, densely punctulate, very finely, densely pubescent. *Legs* thick; basal joint of the hind tarsi quite distinctly longer than the remainder. Length 3.9–4.9 mm.; width 0.8–1.2 mm.

Texas (Austin).

The male has the fifth segment unimpressed, a little longer than the fourth and transversely truncate at apex, the middle of the truncature slightly produced in a minute rounded projection. In the female the fifth segment is much longer, strongly narrowed from base to apex, the rounded apex feebly sinuate in the middle, and the surface broadly impressed; the second ventral has at each side a strong transverse excavation along the basal margin which is wanting in the male. The male intromittent organ is very intricate, having two thick complex lateral lobes, with external pubescent appendages, and a very slender central organ, all of equal length; it is therefore almost of the same general type as in *Pedilus*.

I took a good series of this interesting species in the valley of the Colorado of Texas, in June.

#### ANTHICINI.

The components of this extensive and widely distributed tribe are active ground beetles of predaceous habits. The various genera have not been considered very pronounced or sharply defined hitherto, but the discovery of certain extraordinarily developed and diversified modifications of the mesosternum and its parapleuræ, enables me to delimit those which occur within our territories with much confidence. These wonderful structures by some singular chance seem to have thus far escaped observation, although in several cases they are so radical as to be obtrusively evident, the edge of the large expanded mesosternal plate, for example, being occasionally prominent from a dorsal point of view

in the reëntrant angle at the base of the prothorax, where it bristles with a sparse fringe of long cilia.\*

As these characters are unusual and abnormal, a perfect constancy of form or extent is not to be expected, and the occurrence of transitional groups, in which the mesosternum is variously developed according to the species, might be anticipated. In point of fact, we actually find that in some generic groups, the form and extent of the mesosternum are as constant as the thoracic process of *Notoxus*—another abnormal structure,—or even more so, but in a few others, such as *Vacusus* and especially *Hemantus*, they become variable subgenerically, but still only to a slight extent specifically. The occurrence of these remarkable structures has alone compelled me to increase considerably the number of genera, but it should be mentioned that in every case the validity of the genus is confirmed by other marked peculiarities of special structure, and also by general habitus.

The North American genera of the tribe may be outlined as follows:—

- Pronotum without an elongate corneous process near the apex.....2  
 Pronotum with a large anteriorly porrect subapical process.....11  
**2**—Anterior coxal cavities closed behind, to a certain degree, by an obliteration of the usual posterior emargination; prothorax strongly constricted behind the middle, the depression extending more or less feebly across the dorsal surface; mesosternum extending in one large unbroken plate to the sides of the body, the lateral edges ciliate and largely visible from above.....3  
 Anterior coxal cavities widely open behind, their corneous floor broadly and deeply emarginate posteriorly.....4  
**3**—Head oblong, the eyes very small and anterior; body densely and minutely sculptured and pubescent.....**Dilandius**  
 Head more oval or subquadrate, the eyes larger and submedian in position; body small and subglabrous.....**Formicilla**  
**4**—Penultimate tarsal joint generally just visibly dilated, deeply excavated or longitudinally grooved above and feebly lobed beneath, the last joint inserted discally and far from the apex; elytra entire or nearly so,

\* It is true that LaFerté alludes at some length to this character under the description of *Formicomus leporinus* (Mon., p. 93), but in such a way as to show that he failed completely to grasp its meaning, or to realize its far-reaching taxonomic value in the tribe, his description proving that he even failed to examine the under surface of the insect at all, and I am somewhat surprised to find that the character is passed over even more lightly by Mr. Champion in his description of *F. gracilipes* (Biol. Cent.-Amer., IV, 2, p. 220).

- rounded behind; eleventh joint of the antennæ simple; last joint of the maxillary palpi securiform or somewhat broadly triangular.....5
- Penultimate tarsal joint not dilated and scarcely at all lobed, the last joint subterminal in insertion; elytra generally more or less truncate at apex and frequently greatly abbreviated; eleventh antennal joint bilobed, constricted generally behind the middle; last joint of the maxillary palpi narrow, obliquely truncate at apex.....10
- 5—Mesosternum more or less abnormally dilated laterally.....6
- Mesosternum normally small, with the sides straight and slightly oblique, forming a point between the broad episternum and the coxæ.....9
- 6—Prothorax deeply constricted or abruptly narrowed behind the middle, or near basal third.....7
- Prothorax not constricted at the sides, except occasionally feebly and near the base, the sides oblique and straight.....8
- 7—The constriction extending deeply across the dorsal surface; antennæ thick and submoniliform.....**Tomoderus**
- The constriction not extending across the dorsal surface.
- Antennæ long and slender; anterior lobe of the prothorax rounded.
- Last joint of the maxillary palpi small or moderate, securiform.
- Mesosternum extending in a highly polished plate far toward the sides of the body, its outline rounded; body extremely densely punctate without trace of erect setæ.....**Baulius**
- Mesosternum less extended laterally, its outer margin oblique and straight; thoracic constriction strong; body very sparingly punctate and bristling with long erect tactile setæ.....**Malporus**
- Mesosternum less extended laterally, its outer margin sublongitudinal, scarcely at all oblique and evenly arcuate; thoracic constriction feeble and more posterior; body rather sparsely punctate, feebly pubescent and devoid of long erect tactile setæ; head truncate at base.....**Nathicus**
- Last joint of the palpi very large and dilated, isosceles.....**Lappus**
- Antennæ much shorter; anterior lobe of the prothorax trapezoidal, widest near the apex; last joint of the maxillary palpi moderate in size, securiform; mesosternum as in Malporus and Lappus.....**Thicanus**
- 8—Antennæ slender; mesosternum generally very greatly developed laterally, approaching the sides of the body.....**Vacusus**
- Antennæ stout; mesosternum variable in extent, becoming subgeneric in weight; femora clavate, the anterior strongly so.....**Hemantus**
- 9—Pronotum normal and evenly convex, the head subquadrate or rounded behind.
- Prothorax moderately large, oblique at the sides posteriorly, rarely feebly constricted just before the base; vestiture simple.....**Anthicus**
- Prothorax relatively small, not quite as long as wide, sinuate at the sides posteriorly; elytra relatively larger and longer; vestiture duplex.
- Sapintus**
- Pronotum abruptly declivous and flattened anteriorly, the head strongly triangular; body stout and convex; metasternum short.....**Amblyderus**

**10**—Mesosternum and its parapleuræ as in *Anthicus*.....**Tanarthrus**

**11**—Tarsi shorter than the tibiæ, the penultimate joint slightly dilated.

**Notoxus**

Tarsi very long and filiform, longer than the tibiæ, the penultimate joint evenly cylindrical and not at all thicker.....**Mecynotarsus**

It is unfortunate that in this lineal arrangement *Tanarthrus* has to intervene between *Amblyderus* and *Notoxus*, but it would be still more out of place among the genera allied to *Tomoderus*, where it must otherwise be placed.

### **DILANDIUS** n. gen.

The two species separated under this name, together with *Formicilla*, are peculiar in having the acute side-pieces of the prosternum behind the coxæ more inwardly prolonged than in *Anthicus*, so that they coalesce at or near the middle, thus closing the coxal cavities. In the other genera, as I find by dissecting numerous divergent forms, the inferior flanks of the prothorax form angular inward projections behind, which are widely separated by a deep emargination of the common coxal floor, and the coxal cavities are consequently broadly open. The mesosternum in this genus extends in one extremely large unbroken polished plate from side to side of the body, and is largely visible from above in the reëntrant humeral angle; the prominent lateral edges of this plate bear a sparse fringe of long stiff bristling setæ.

In the form of the head *Dilandius* resembles *Ochthenomus* to a great degree, the outline being oblong-suboval, with the eyes small and anterior.

Our two species are very slender ant-like insects, distinguishable at once from *Malporus* and *Lappus* by the form of the head, disposition of the elytral vestiture, and by the fact that the lateral constriction of the prothorax extends across the dorsal surface, giving rise to two convex lobes.\* They may be known as follows:—

Dorsal constriction of the prothorax strong; white pubescent fascia of the elytra oblique.....1. **myrmecops**  
Dorsal constriction feeble; pubescent fascia transverse.....2. **unicus**

---

\* In the second group of *Lappus* there is a large dorsal gibbosity near the base of the pronotum, but this is a true protuberance, and is not produced by a dorsal extension of the lateral constriction; in *gibbithorax* and others of this group, there is no transverse depression before the protuberance.

The representatives of this genus are very rare in collections, and scarcely anything can be stated in regard to their true geographical distribution.

1. **D. myrmecops** n. sp.—Very slender and elongate, black, the sterna of the hind body and elytra below the humeri paler; antennæ pale flavo-testaceous, the last four or five joints dark; legs pale ochreous throughout. *Head* oblong, rounded at base, the sides parallel for a long distance behind the eyes, which are small, anterior and scarcely at all prominent; surface moderately convex, rather coarsely, very densely punctate, the punctures confluent laterally, feebly pubescent; antennæ long, slender, one-half as long as the body, the third joint distinctly longer than the fourth, outer joints slightly thicker. *Prothorax* slightly narrower than the head, much longer than wide, deeply but not acutely constricted at basal third, the anterior lobe almost regularly globular; collar distinct, finely, deeply constricted; basal margin wide but not at all tumid, defined by a fine impressed line and by its less sculptured surface; disk extremely minutely and densely punctate, and densely clothed with minute decumbent hairs. *Elytra* much longer than the head and prothorax combined, deeply, transversely impressed near the base, slightly dilated and moderately convex behind, twice as wide as the prothorax, nearly twice as long as wide, densely, extremely minutely and scarcely visibly punctulate, the pubescence very short and decumbent, dusky-cinereous and inconspicuous except in a transverse basal band and broader fascia at basal two-fifths, where it is brown, the posterior brown fascia bordered anteriorly on each elytron with a narrow oblique fascia of coarser silvery-white pubescence. Under surface minutely, densely punctate and pubescent. *Legs* moderate in length, rather thick, minutely pubescent. Length 2.8 mm.; width 0.7 mm.

Southern Illinois.

The upper surface is beset with extremely sparse and perfectly erect stiff setæ, rather long on the elytra. The male has the fifth ventral unmodified, the minute genital segment deeply and circularly emarginate throughout its width at apex.

A single specimen, kindly given me a few years since by Mr. F. M. Webster.

2. **D. unicus** n. sp.—Slender, dull black, the tarsi and basal joints of the antennæ testaceous; legs, under surface of the hind body, and eleventh antennal joint more or less pale piceous. *Head* convex, oblong-oval, broadly rounded at base, rather coarsely and very densely punctate, feebly pubescent, the eyes very small and anterior; antennæ one-half as long as the body, slender toward base but gradually quite thick toward apex. *Prothorax* much narrower than the head and much longer than wide, the constriction near basal third deep and broadly angulate at the sides, the apical lobe subglobular and rather longer than wide; collar distinct; basal margin wide, flat, defined only

by a fine line; disk minutely, very densely punctate, and densely clothed with minute closely decumbent pubescence. *Elytra* strongly, transversely impressed near the base, distinctly dilated behind, rather more than twice as wide as the prothorax, not quite twice as long as wide, and not longer than the head and prothorax together, dull, densely, extremely minutely and almost invisibly punctate, densely clothed with very minute, closely decumbent, dark gray and inconspicuous pubescence, coarser and brown in a transverse fascia at basal two-fifths, immediately before which there is a transverse fascia of longer, less decumbent, coarser silvery pubescence; apex broadly, obtusely rounded. Under surface and legs minutely and densely pubescent, the latter relatively rather long. Length 2.3 mm.; width 0.55 mm.

Florida (Haw Creek). Hubbard and Schwarz.

The erect, widely dispersed setæ of the upper surface are short throughout, but those of the bristling fringe along the lateral edges of the mesosternum, visible from above, are very long and conspicuous. Sexual characters are not apparent in the single specimen before me.

#### **FORMICILLA** Lec.

The very small polished and sparsely setose species, for which this genus was erected by LeConte (Ann. Lyc. Nat. Hist., N. Y., V, p. 152), certainly cannot be associated with the large forms of totally different habitus, which include the types of *Formicomus* Laf., nor can they be placed with *Anthicus*, as subsequently suggested by LeConte (Proc. Acad. Nat. Sci., Phila., 1852, p. 94), because of the remarkable structure of the mesosternum. The only course left, therefore, is to regard them as constituting a distinct genus.

The anterior coxal cavities are closed behind by an extension of their corneous floor, and, in *scitula*, the median line of the floor is produced behind in a slender cusp-point which, however, does not project posteriorly further than the lateral lobes, from each of which it is separated by a small deep rounded emargination. The fourth palpal joint is only moderately large, triangular and obliquely truncate.

The species are confined to the extreme south of the United States, from the Atlantic to the Pacific, extending also into Mexico, but the approximate southern limits of range are not at present determinable.

Our four species may be known as follows:—

Anterior lobe of the prothorax globular or at least as long as wide.

Elytra short, much narrowed but almost completely unimpressed on the disk near the base, and devoid of shorter subdecumbent hairs.

**1. scitula**

Elytra longer, less narrowed at base, but distinctly impressed behind the omoplates, having short sparse subdecumbent hairs in addition to the long erect setæ.....

**2. munda**

Anterior lobe larger, wider than long.

Elytra pale, with the humeri and two broad fasciæ of black; head quadrate, subtruncate at base .....

**3. evanescens**

Elytra black, with two narrow pale fasciæ, one near the base, the other before apical third; head narrower, more elongate and more rounded at base.....

**4. gilensis**

The species are very homogeneous in point of size and others will undoubtedly be discovered; those above outlined are divisible into two subgeneric groups, the first represented by *scitula* alone, as shown by antennal structure, and the second by the last three species.

**1. F. scitula** Lec.—Proc. Acad. Nat. Sci., Phila., 1852, p. 94 (Anthicus).

Convex, highly polished, with some widely scattered punctures bearing long tactile setæ, but otherwise completely impunctate and devoid of sculpture, pale rufo-testaceous, the head slightly less pale; elytra with two broad fasciæ of black, the first before the middle completely interrupted at the suture, the second near but not enveloping the apex and produced slightly along the suture anteriorly in a short cusp. Head oval, convex, rather longer than wide, broadly rounded and unimpressed at base; eyes rather small, just before the middle, convex and coarsely faceted; antennæ one-half as long as the body, slender but distinctly and gradually incrassate, the last joint rather thicker, obtusely and obliquely pointed and fully as long as the preceding two. Prothorax distinctly narrower than the head, elongate, convex, strongly constricted before basal third; collar short but deeply constricted; basal margin present. Elytra short, oval, connate, one-half longer than wide, nearly two and one-half times as wide as the prothorax, much rounded at the sides and narrowed at base, the humeri broadly and obliquely rounded at base but distinct. Length 1.9–2.0 mm.; width 0.65–0.7 mm.

South Carolina,—Cab. LeConte; Florida (Sebastian River), Hubbard and Schwarz. The male has the fifth ventral almost as long as the preceding two, evenly and not broadly rounded and



slightly flattened in the middle at apex; the genital segment is large, deeply and angularly incised in the middle and acutely bilobed.

2. **F. munda** Lec.—Ann. Lyc. Nat. Hist., N. Y., V, p. 152; Proc. Acad., 1852, p. 95 (Anthicus).

Less stout and more parallel, convex, highly polished, with some widely scattered punctures bearing long tactile setæ, and also having some very sparse subdecumbent hairs, otherwise completely devoid of sculpture, pale flavo-testaceous, the head not darker; elytra with the tips of the humeri, a broad band just before the middle narrowed toward, and narrowly interrupted at the suture, and a subapical band also narrowly interrupted, blackish. Head oval, a little longer than wide, broadly rounded at base; eyes small but convex, just before the middle; antennæ one-half as long as the body, slender but rapidly and very strongly incrassate through the last four joints, the eleventh conoidal and very much shorter than the two preceding. Prothorax only slightly narrower than the head, distinctly longer than wide, convex, deeply but not very acutely constricted rather behind basal third; basal margin distinct. Elytra nearly two-thirds longer than wide, scarcely more than twice as wide as the prothorax, rounded behind, not connate, the hind wings apparently rather well developed; sides feebly inflated behind; humeri distinct and well exposed at base; disk distinctly impressed at basal fourth. Legs rather long and slender, the femora moderately stout. Length 1.9–2.0 mm.; width 0.6 mm.

California (Yuma). In the male the fifth ventral is evenly rounded behind, unmodified and very much shorter than the two preceding together, the genital segment small, parabolic in outline, the apex with a small but rather deep and very acutely attenuate notch, each of the small lobes inflexed and almost meeting at apex; the copulatory spicule is long, extremely slender and gradually finely pointed, the under surface very feebly impressed along the median line, more strongly toward base. This species, although congeneric, is remarkably distinct from *scitula*.

3. **F. evanescens** n. sp.—Moderately stout, convex, highly polished, bristling above with long remote tactile setæ and also having a few shorter distant and more decumbent hairs; integuments without sculpture, pale testaceous, the elytral humeri and a median and apical band not interrupted at the suture, black. Head subquadrate, scarcely longer than wide, broadly arcuato-

truncate at base, the angles rounded; tempora parallel; eyes small and feebly convex; antennæ nearly one-half as long as the body, gradually and strongly incrassate, the eleventh joint much shorter than the two preceding. *Prothorax* only just visibly narrower than the head, a little longer than wide, deeply constricted near basal third, the anterior lobe very large, wider than long and widest near its anterior third, somewhat trapezoidal, the sides arcuate; basal margin distinct; collar very short but deeply constricted. *Elytra* two-fifths longer than wide, abruptly, obtusely rounded behind, inflated and distinctly wider in the middle than at base; humeri distinct; disk transversely impressed near the base; omoplates large and only moderately prominent. *Abdomen* finely but sparsely pubescent. *Legs* moderately short and stout, pubescent. Length 1.9 mm.; width 0.7 mm.

Texas (Austin).

The single specimen is a female and represents a species allied distinctly to *munda*, but differing markedly in the form of the prothorax and in the quadrate head.

4. ***F. gilensis*** n. sp.—Narrow, convex, polished and sculptureless throughout the upper surface, with some short and slender and long stiff bristling setæ; body black, the metasternum, legs and prothorax more or less rufescent; antennæ pale testaceous; elytra with a narrow straight flavous fascia near the base and another, similar, distinctly behind the middle. *Head* oval, rather longer than wide, rounded at base, the angles very broadly rounded; eyes small, just before the middle, convex and prominent; antennæ rather less than one-half as long as the body, gradually and moderately incrassate, the last joint as in *munda*. *Prothorax* scarcely visibly narrower than the head, distinctly longer than wide, deeply constricted near basal third, the anterior lobe wider than long, subelliptical and widest rather before the middle; basal margin distinct. *Elytra* one-half longer than wide, barely twice as wide as the prothorax, almost evenly, not abruptly rounded behind, quite distinctly inflated, and noticeably wider at or just behind the middle than at base; humeri distinct, widely exposed and obliquely rounded at base; disk feebly impressed near the base. *Abdomen* finely and rather densely pubescent. *Legs* distinctly and more coarsely pubescent, moderately long, the femora quite stout and subpedunculate. Length 2.0 mm.; width 0.65 mm.

Arizona (Tucson).

The single male, from which this description is drawn, has the copulatory spicule almost completely protruded; it is of singular form and very simple structure, three-fifths as long as the entire abdomen, slender, nearly straight in profile and gradually acutely and extremely finely attenuate from base to apex, the sides straight; the slender efferent duct beneath is much shorter, and is only partially and basally sheltered in the inferior excavation of the spicule, the latter scarcely serving as a protective sheath.

**TOMODERUS** Laf.

The species of this well marked genus very closely resemble each other in general appearance. They are robust and convex in body, with stout, moniliform, strongly incrassate and perfoliate antennæ, deeply segmented prothorax, subserial elytral punctuation, moderately developed mesosternal plate and stout clavate femora.

The hind coxæ are widely separated by a short, broadly rounded projection of the first abdominal segment, the tibial spurs apparently wholly obsolete, and the fourth palpal joint moderately developed, triangular and obliquely truncate. The eyes are rather small, moderately convex and somewhat coarsely faceted. The transverse dorsal constriction of the pronotum is generally more or less distinctly and coarsely sculptured at the bottom, and the basal marginal line is wholly obsolete; the apical collar is also obsolete or extremely rudimentary, the head being in close contact with the anterior lobe of the prothorax, and the neck somewhat wider as well as shorter than in *Anthicus*.

Our three species may be thus distinguished:—

Anterior lobe of the pronotum without an impressed median line.

Elytral punctures distinct throughout, becoming very gradually coarser and confusedly subserial in arrangement toward base.....1. **abbreviatus**

Elytral punctures very fine, becoming abruptly coarse and distinctly seriate in basal third or fourth; apical segment of the abdomen longer in both sexes.....2. **constrictus**

Anterior lobe broader and generally more narrowly rounded at the sides, having a feebly impressed median canaliculation which does not attain the apex; elytra shorter, the sculpture nearly as in *abbreviatus*, the pubescence denser.....3. **impressulus**

*Tomoderus*, as here understood, extends throughout the United States, east of the Rocky Mountains and far into Mexico, but does not occur near the Pacific coast.

1. **T. interruptus** Laf.—Mon., p. 97; Lec.: Proc. Acad., Phila., 1852, p. 94.

Stout, convex, highly polished throughout, blackish, the elytra rufescent in basal half; pubescence of the anterior parts very sparse and inconspicuous, these subimpunctate, that of the elytra moderate in length, suberect, not very dense though rather coarse. Elytral punctures arranged in very uneven series toward base,

becoming gradually stronger. Length 2.3–2.7 mm.; width 0.8–1.0 mm.

Indiana, Kentucky and Iowa. This species has been well described by LaFerté, though I have never seen an example in which the punctures are completely confused toward the elytral base; it is especially abundant in the Mississippi valley, while the following is the common species along the Atlantic coast. The fifth ventral in the male is short, only one-third longer than the fourth, narrowly subtruncate at the middle of the apex, the edge thence oblique and straight nearly to the sides, then rounded to the base, the genital segment large and broad, pale and subcoriaceous, transversely convex throughout the width and subtruncate at apex. In the female the fifth ventral is much longer, two-thirds longer than the fourth, and is evenly rounded in circular are throughout.

2. **T. constrictus** Say—Journ. Acad. Nat. Sci., Phila., V, p. 244 (Anthicus); LaFerté: Mon., p. 101; LeConte: Proc. Acad., Phila., 1852, p. 94 (Tomoderus).

Similar to the preceding in general form and sculpture, but with the elytra a little shorter and stouter and pale only in basal third or fourth, with the punctures very fine, becoming abruptly coarse and more distinctly seriate in the pale area. Length 2.4–2.7 mm.; width 0.8–1.0 mm.

New York, Rhode Island and Michigan. The male has the fifth ventral fully three-fourths longer than the fourth, transversely truncate in median fourth at apex, the edge thence oblique and straight to near the sides, then gradually rounded to the base, the genital segment transversely, evenly convex and truncate at apex, nearly as in *interruptus*. In the female the fifth ventral is fully three-fourths longer than the fourth, and is evenly and somewhat parabolically rounded behind.

3. **T. impressulus** n. sp.—Moderately stout, convex, highly polished, the head and pronotum subimpunctate and clothed very sparsely with fine subdecumbent hairs, the elytra finely, sparsely but distinctly punctate, the punctures becoming rather gradually coarse and more distinctly seriate in arrangement toward base, with the pubescence moderate in length, suberect, coarse and rather dense; body dark rufo-testaceous, piceous-black beneath, the abdomen paler at apex; head darker; legs and antennæ pale flavo-testaceous, the latter gradually darker or more rufous toward base; elytra varying from rufo-testaceous to piceous-black throughout, sometimes just visibly and very

gradually and indefinitely paler toward base. *Head* wider than long, truncate but not impressed at base; angles rounded; tempora thence straight and divergent to the eyes, which are rather small and slightly prominent; antennæ very thick, fully as long as the head and prothorax, the penultimate joints strongly transverse. *Prothorax* just visibly narrower than the head, a little longer than wide, deeply and acutely constricted at basal two-fifths, the constriction with coarse cellular sculpture; anterior lobe very strongly transverse and distinctly impressed along the median line. *Elytra* short, barely one-half longer than wide, twice as wide as the prothorax in the male, slightly wider in the female, slightly inflated at the middle, obtuse and transversely arcuate at apex, the humeri rather widely exposed and rounded to the prothorax; basal impressions and omoplates obsolete. *Abdomen* finely and rather closely punctate. *Legs* moderate in length, the hind tarsi slender. Length 2.3 mm.; width 0.8 mm.

North Carolina (Asheville).

The male sexual characters are nearly as in the preceding species, the fifth ventral in the male being about one-half longer than the fourth. In the female it is three-fourths longer than the fourth, and more evenly rounded.

This species is allied to *interruptus*, but may be distinguished by the shorter, more unicolorous and more densely pubescent elytra, impressed pronotum and somewhat smaller size. Three specimens.

#### **BAULIUS** n. gen.

The body is rather narrow, convex, subopaque from the minute and very dense punctures and extremely short fine decumbent pubescence. Head subhexagonal, rather longer than wide, convex, the sides behind the eyes convergent and nearly straight for a long distance, the base broadly, feebly arcuate; eyes rather large and prominent; antennæ long and very slender, with the third and fourth joints equal and longer than the second; fourth palpal joint only moderately dilated. Prothorax slightly narrower than the head, much longer than wide, the anterior lobe subglobular, the collar wide and prominent, cylindrical, the basal lobe gradually expanded to the base, the basal margin flat, defined by a fine line. Elytra more than twice as wide as the prothorax, nearly twice as long as wide, distinctly expanded behind, the sides broadly arcuate; disk transversely impressed near the base, the depression traversed by a perfectly even parallel-sided, narrow and abruptly defined transverse fascia of pale yellowish-white. Legs rather long, the femora feebly incrassate; tibiæ cylindrical, clothed with minute decumbent pubescence, longer than the tarsi; first

joint of the posterior tarsi scarcely as long as the remainder, the third short. Mesosternum expanded in a broad, highly polished impunctate and glabrous plate, its outline at the sides rounded and not furnished with long setæ, the episternum tumid, visible from above, discontinuous in level with the met-episternum, the mes-epimeron very narrow and subobsolete.

The type is *Anthicus tenuis* of LeConte (Ann. Lyc., N. Y., V, p. 153), very abundant in the desert regions from western Texas to southern California. The male has the fifth ventral much longer than the preceding, rather strongly rounded at apex and unmodified, the sixth or genital segment coriaceous, emarginate in the middle at apex, the copulatory spicule abruptly narrowed and prolonged for a short distance at apex.

#### MALPORUS n. gen.

In this genus the head is more strongly and circularly rounded behind than in Lappus, and the sculpture and vestiture of the body are peculiar, the elytra being very coarsely and unequally punctate and bristling with long erect tactile setæ. The last joint of the maxillary palpi is moderate in size, and very different from the form occurring in the genus Lappus. Our species may be distinguished thus:—

Elytral punctures distinct throughout the disk, though fine and remote toward apex, closer and coarse before the middle; posterior part of the disk but slightly convex in profile; elytra but slightly narrowed toward base.

Prothorax very strongly constricted; body throughout more sparsely punctate, the elytra without an apical pale spot.....1. **formicarius**

Prothorax much less strongly constricted; punctures throughout denser; elytra more parallel, the pale fascia less basal, each having an apical pale spot; antennæ longer and more slender.....2. **cinctus**

Elytra devoid of distinct punctuation, except in the subbasal impression which is strong.

Elytra elongate, the pronotum not impressed.....3. **properus**

Elytra much shorter and more strongly convex in profile, the pronotum feebly impressed along the median line.....4. **blandus**

The corneous copulatory sheath of the male is elaborately modified in this genus as described below, the efferent duct lying in a cavity of the under surface. In comparing this structure, which is the prevailing type throughout the Anthicini, with the projecting "spike" which I have previously noted in *Hymenorus* (Col. Not. III, pp. 70, 89), the homology seems to be evident,

and the organ there alluded to is probably the mobile efferent duct bent downward from the protecting corneous sheath.

1. **M. formicarius** Laf.—Mon., p. 185; Lec.: Proc. Ac. Nat. Sci., Phila., 1852, p. 97; *cinctus* var. A, Say: Journ. Ac. Nat. Sci., Phila., 1819, p. 278 (*Anthicus*).

Moderately stout, highly polished, black, the bases of the prothorax and elytra feebly rufescent; sterna and antennæ toward base, rufo-testaceous; legs blackish, the tarsi and base of the femora testaceous. Head subimpunctate, rather longer than wide, semi-circularly rounded behind the eyes, which are moderate in size and rather prominent; occiput with a foveiform impression at the middle of the base; antennæ long, distinctly and gradually incrassate, the tenth joint slightly longer than wide, the third and fourth elongate and subequal. Prothorax much longer than wide, distinctly narrower than the head, globularly convex before the constriction and expanded toward base, the punctures minute and very remote, except in the middle toward base, where they become larger, dense and distinct. Elytra almost twice as long as wide, feebly dilated behind, about two and one-half times as long as the prothorax, the scutellar impression deep, the omoplates prominent; disk scarcely visibly impressed near the base, but having a transverse and well defined yellow band at basal fourth interrupted at the suture; punctures coarse and sparse from the base to about the middle, thence gradually very fine and remote to the apex, the pubescence short, stiff, semi-erect and remote, with erect widely dispersed bristles intermingled. Abdomen shining and sparsely pubescent. Length 3.0–3.5 mm., width 0.8–1.0 mm.

Rhode Island to Iowa. The type above described is a male from the shores of Narragansett Bay, and differs slightly from some of the western specimens in its smaller size, rather narrower head and sparser punctuation.

The œdeagus of this species is very complex. The genital segment is short and simple, with a rounded shallow sinuation at the middle of the apex subequal in extent and degree of curvature to the lateral lobes. The efferent duct is extremely long and slender, lying in the wide deep inferior opening of a long broad sheath, which is parallel-sided and flattened dorsally for the greater part of its length, but narrowed near the apex, where it becomes split into three lobes of equal length, the two lateral hollowed internally and finely setose within at

tip, the median being drawn out to a very minute slender point; the slender intromittent duct proper, lying within the widely open under surface of this sheath, is cylindrical and feebly, broadly constricted at apical fourth, failing to attain the tip of the acute median process of the sheath by a fifth or sixth of its own length; it is gradually and feebly bent downward toward apex. The entire organ as protruded in this specimen is rather more than one-half as long as the abdomen.

2. **M. cinctus** Say—Journ. Acad. Nat. Sci., Phila., 1819, p. 278; Lec.: Proc. Ac. Nat. Sci., Phila., 1852, p. 97 (Anthicus).

This species differs from *formicarius* in its larger size, longer, more filiform, scarcely incrassate antennæ, much larger and more prominent eyes, denser punctures of the pronotum and elytra, the latter being more parallel and scarcely at all dilated behind the middle, and in coloration, *cinctus* being pale rufo-testaceous in color, with the elytra blackish except toward base, and with an apical pale spot which is always wanting in *formicarius*; it also differs in the position of the transverse pale fascia, this being situated more nearly at basal third than fourth. In the present species the omoplates are very prominent, but the transverse impression of the elytra behind them is obsolete. Length 3.7 mm.; width 1.2 mm.

Illinois and Iowa. Apparently not abundant.

3. **M. properus** n. sp.—Rather slender and convex, highly polished, dark rufo-piceous, the elytra black except at base; antennæ more obscure toward apex. *Head* orbicular, not longer than wide, convex, minutely, very remotely punctate, semi-circularly rounded behind, very broadly and obsoletely impressed at base; eyes rather large and prominent; antennæ slender, very feebly incrassate, more than two-fifths as long as the body, the third joint slightly longer than the fourth, tenth much longer than wide. *Prothorax* distinctly narrower than the head and longer than wide, globularly convex before the constriction, expanded toward the distinct basal margin; disk subimpunctate except toward the middle posteriorly, where the punctures are coarse and dense. *Elytra* elongate, twice as long as wide, a little more than twice as wide as the prothorax, feebly dilated behind the middle, thence gradually and not very obtusely rounded behind; humeri widely exposed, the mes-episterna visible from above; disk deeply impressed near the scutellum, the omoplates prominent; transverse constriction near the base strong, the portion of the surface thence to the apex moderately convex in profile; punctures minute and very widely dispersed throughout, except in the transverse depression, where they become coarse, and where there is a transverse even



and non-interrupted fascia of pale yellow. Under surface shining, the abdomen finely, sparsely punctate. *Legs* long and slender, the femora feebly thickened. Length 3.3 mm.; width 0.9 mm.

Iowa (Keokuk); Indiana.

The strong basal impression and minute punctuation of the elytra, larger eyes and slender, scarcely incrassate antennæ, will readily distinguish this species from *formicarius*. The transverse fascia is more basal than in *formicarius*, being at about basal fifth, and the sexual characters of the male are very different, the genital segment being emarginate almost throughout its width, the bottom of the emargination broadly trisinate; the hind tibiæ are bisinate in curvature. The erect sparse setæ of the elytra are very long and conspicuous.

4. **M. blandus** n. sp.—Moderately stout, strongly convex, highly polished, piceous-black; basal parts of the antennæ and elytra rufescent. *Head* rather longer than wide, convex, minutely, remotely punctate, broadly rounded at base and not impressed, the temporal angles less broadly rounded; eyes large, prominent; antennæ two-fifths as long as the body, rather thick, moderately incrassate, the third joint distinctly longer than the fourth, tenth but little longer than wide. *Prothorax* small, very much narrower and rather shorter than the head, a little longer than wide, the anterior lobe transversely oval, the basal expanded to the distinct hind margin; collar wide and pronounced; disk subimpunctate, except finely and rather sparsely in the middle toward base, impressed along the median line almost throughout the length. *Elytra* short, barely three-fourths longer than wide, much wider behind the middle than at base, and about two and one-half times as wide as the prothorax, thence broadly, rather obtusely rounded behind, the humeri widely exposed, the mes-episternum only very minutely visible from above, feebly deliscent near the apex, the sutural angles rounded; fine elevated margin of the suture terminating at some distance before the apex; disk deeply impressed behind the scutellum, the omoplates prominent, also strongly and transversely impressed at basal fifth, the impression alone strongly punctate and transversely fasciate with yellow; surface thence to the apex strongly convex in profile and minutely remotely and scarcely visibly punctate; erect setæ long and remote, the finer inclined hairs only distinct toward base. *Abdomen* polished, black, finely, remotely punctate. *Legs* long and slender. Length 3.0 mm.; width 0.9 mm.

New York (Willels Point, Long Island).

This very distinct species may be distinguished from *properus* by its smaller, less punctate and feebly canaliculate prothorax, with the anterior lobe more transverse, by its shorter, more posteriorly convex elytra, shorter and stouter antennæ, unimpressed occiput and many other characters.

**NATHICUS** n. gen.

The general aspect of the only species at present assignable to this genus recalls some of the members of *Vacusus* in sculpture and coloration. The body is sparsely clothed with short hairs, the head truncate at base, with rather large convex and coarsely faceted eyes, the terminal joint of the maxillary palpi small and securiform and the antennæ moderately elongate. Prothorax broad, evenly and moderately convex, with the collar extremely short, and the basal margin narrowed strongly toward the middle in a peculiar manner, the lateral constriction much feebler than in *Baulius* or *Malporus*, nearer the base and rounded. Scutellum small, triangular, finely and densely sculptured, densely pubescent. Elytra with well exposed humeri, the short sparse vestiture intermingled only toward apex with a few very short erect and remotely scattered setæ. Sexual characters not observed and apparently very feeble.

1. ***N. virginiae*** n. sp.—Moderately stout and convex, polished, pale rufo-testaceous, the legs pale flavate; elytra with the basal margin, a broad fascia at or just before the middle and another at apex, the latter slightly prominent anteriorly at the suture, black; vestiture short, sparse, subdecumbent, rather coarse on the elytra. *Head* a little wider than long, transversely truncate but not distinctly impressed at base, the angles rounded to the eyes, the tempora much less prominent; eyes large, very convex, prominent and at about one-half their length from the base; surface moderately convex, rather finely but strongly and somewhat sparsely punctate, with a large subimpunctate median area; antennæ moderately slender, barely as long as the head and prothorax, distinctly incrassate toward apex, the third joint longer than the fourth, tenth trapezoidal, scarcely as long as wide, the eleventh short, conoidal. *Prothorax* distinctly narrower than the head, as long as wide, the anterior lobe nearly three-fourths of the entire length, wider than long, with the sides evenly and circularly arcuate; basal lobe expanded at base, the latter broadly arcuate and four-fifths as wide as the disk; apical collar very short, broad, conical, separated from the lobe by an extremely fine impressed line; disk feebly and broadly convex, rather coarsely, very closely punctate, the punctures circular and in the form of a shallow basin, the hairs attached at the anterior wall. *Elytra* large, four-fifths longer than wide, a little more than twice as wide as the prothorax, gradually narrowed and obtusely ogival in apical third, completely concealing the pygidium, and each slightly rounded at the extreme apex; sides parallel and broadly arcuate; humeri broadly and obliquely exposed at base; disk with scarcely a trace of basal impression or omoplates, coarsely deeply and not densely punctate, the punctures becoming much smaller toward apex. *Abdomen* distinctly, sparsely and unevenly punc-

tate toward base, the punctures becoming gradually very minute und rather dense toward apex. Prosternum before the coxæ densely and finely punctato-scabrous and clothed densely with long fine pubescence. Mesosternal process very narrow, not extending to the apices of the coxæ, and separated from the short, obtusely cuspiform process of the metasternum by an appreciable interval. Mesosternal epimeron with a posterior fringe of long dense hairs as in *Sapintus*. *Legs* rather long, very slender. Length 3.0 mm.; width 1.05 mm.

Virginia (Fort Monroe).

This is one of the most conspicuous and interesting anthicides of our fauna. I owe two specimens to the kindness of Messrs. Hubbard and Schwarz.

#### LAPPUS n. gen.

The species composing this genus have heretofore been regarded as a simple section of *Anthicus*, but the structure of the mesosternum and prothorax, as well as their peculiar general habitus, demands a separation of them from that unwieldy complex. They are very numerous in the United States, especially in the arid southwestern country, as shown by the results of recent skillful collecting in those regions.

This genus differs from the others more closely allied, in the great development of the fourth joint of the maxillary palpi, and the long tactile setæ, which are so conspicuous a feature in *Malporus*, are completely wanting; the punctuation is very fine and dense as a rule, also in striking contrast to that genus. In regard to the ædeagus, I have seen no specimen with the apparatus sufficiently protruded for examination, and I have not had enough time or duplicate material to make dissections, but it is doubtless somewhat complex in structure.

It is scarcely possible that *Lappus* can be identical with the South American *Ischyropalpus* of LaFerté, for neither *Lappus obscurus* nor *L. sturmi* (*elegans*) seems to have suggested to the author an alliance with *Ischyropalpus perplexus* (Mon., p. 142), but in case *obscurus* and *perplexus* should prove to be congeneric, there is no reason why the name *Ischyropalpus* should not be restricted to either *sericans* or *trigonocephalus* (l. c., pp. 143, 146), as the first is probably, and the second certainly, generically different from *perplexus*.

Our species, so far as known, may be conveniently separated by the following synoptic table:—

## GROUP I.

*Pronotum not tumid near the base.*

Elytra dark, with a pale transverse fascia behind the base; antennæ stout and short, the tenth joint not at all longer than wide.....1. **pinalicus**

Elytra unicolorous, or with the entire basal region paler; antennæ long, filiform, frequently distinctly and very gradually incrassate.

Elytra distinctly transversely impressed near the base.....2

Elytra not impressed near the base, or very indistinctly so, smaller and more delicate species, the eyes moderate or small in size,.....6

2—Anterior lobe of the prothorax almost evenly rounded at the sides, widest at about the middle.....3

Anterior lobe unevenly rounded, more strongly so and widest near the base, the constriction more abrupt; posterior lobe gradually and moderately expanded to the base; head strongly, asperately punctate and comparatively small. California.....5

3—Body and legs testaceous, the abdomen and posterior parts of the elytra generally black or piceous.....4

Body and legs black throughout.....2. **obscurus**

4—Head asperately and more closely punctate.

Anterior lobe of the prothorax subglobular; antennæ very slender.

3. **vigilans**

Anterior lobe distinctly transverse, the antennæ a little shorter and thicker, with the joints distinctly less elongate.....4. **cursor**

Head minutely, remotely and not asperately punctate.

Elytra slightly or not at all narrowed at base; posterior lobe of the prothorax gradually expanded to the basal margin.

Antennæ slender, the joints greatly elongate and subcylindrical.

Elytra gradually narrowed behind the middle.....5. **alacer**

Elytra parallel, more abruptly and broadly rounded at apex.

6. **nubilatus**

Antennæ shorter and stout, strongly incrassate, the joints obconical.

7. **lividus**

Elytra strongly narrowed at base, the posterior lobe of the prothorax cylindrical with the sides parallel; antennæ rather stout and strongly incrassate, (*elegans* || Laf.).....8. **sturmi**

5—Body completely black, the legs sometimes feebly picescent; antennæ moderately slender.....9. **nitidulus**

Body rufo-testaceous, the abdomen and posterior parts of the elytra black.

Antennal joints moderately elongate, obconical, much thicker toward apex.

10. **asperulus**

Antennal joints greatly elongate, subcylindrical, only slightly thicker toward apex.....11. **canonicus**

6—Elytra pale at base.....7

Elytra unicolorous.....8

7—Elytra very feebly impressed, slightly dilated behind the middle.

Eyes moderate, prominent; body black, the elytra pale only very near the base; antennæ long.....12. **ornatellus**

- Eyes small; body testaceous, the elytra dark except in basal third or fourth; antennæ shorter.....13. **vividus**
- Elytra not appreciably impressed, parallel; body pale testaceous throughout, the elytra abruptly dark in apical three-fifths.....14. **bipartitus**
- S**—Elytra distinctly impressed near the scutellum, the omoplates prominent. Elytra parallel almost to the apex, abruptly and obtusely rounded behind. Rufo-testaceous, the elytra piceous; prothorax large; head flattened anteriorly.....15. **turgidicollis**
- Piceous throughout; prothorax small, the head convex...16. **subtilis**
- Elytra gradually narrowed behind from just behind the middle, narrowly rounded at apex.....17. **animatus**
- Elytra not distinctly impressed near the scutellum, nearly even, subparallel toward base; prothorax not longer than wide; antennæ long.
18. **solivagans**

## GROUP II.

*Pronotum with a strong tumid elevation near the base.*

- Reddish-testaceous, with the abdomen and posterior two-thirds of the elytra blackish .....19. **gibbithorax**

1. **L. pinalicus** n. sp.—Rather slender, the elytra somewhat flat, rather dull in lustre, rufo-piceous, the elytra black with a transverse flavate and ill-defined fascia near the base; antennæ black, testaceous near the base; legs pale. *Head* only feebly convex, scarcely as long as wide, broadly, evenly arcuato-truncate at base, unimpressed, the eyes large, prominent, the tempora short behind them, rounding into the base; surface finely, closely punctate and feebly reticulate; antennæ stout, incrassate, barely as long as the head and prothorax, the tenth joint scarcely as long as wide, still broader in the female. *Prothorax* large, very strongly convex, only slightly narrower than the head, distinctly longer than wide, the anterior lobe large and subglobular, the posterior rather short and parallel, the basal margin distinct; collar short; disk finely evenly and rather closely punctate throughout, the pubescence fine and short. *Elytra* fully three-fourths longer than wide, twice as wide as the prothorax, just visibly wider behind the middle than at base, thence gradually narrowed to the tip, which is somewhat narrowly subtruncate; disk finely evenly and densely punctate, the punctures asperate toward base, broadly, very feebly, transversely impressed near the base along the wide yellow fascia; omoplates scarcely at all prominent; ashy pubescence short, rather dense and conspicuous. Under surface finely, sparsely punctate and pubescent. *Legs* moderate in length, the femora rather stout. Length 2.1–2.6 mm.; width 0.65–0.7 mm.

Arizona (Pinal Mts.—near the southern border). Mr. Wickham.

The male has the fifth ventral distinctly longer than the fourth, narrowly truncate at tip and broadly, feebly impressed at the center of the disk, the genital segment broadly, feebly sinuato-truncate throughout its width.

2. **L. obscurus** Laf.—Mon., p. 116; Lec.: Proc. Ac. Nat. Sci., Phila., 1852, p. 96 (*Anthicus*).

Moderately stout, the elytra feebly narrowed behind the middle, the head and eyes rather small, shining, black throughout, the punctures fine, close toward the median line of the prothorax and slightly coarser in basal fourth of the elytra, where also the pubescence becomes pale ashy, coarser and distinct though scarcely denser. The subbasal impression of the elytra is only moderately distinct. Length 2.65 mm.; width 0.85 mm.

The specimens in my cabinet are females and were taken in Pennsylvania, North Carolina (Asheville) and Indiana. The species has been well described by LaFerté.

3. **L. vigilans** n. sp.—Polished, dark rufo-testaceous, the abdomen, posterior parts of the elytra and antennæ from the fourth or fifth joint, piceous-black. *Head* rather large, wider than long, strongly, rather closely, asperately punctate, each puncture bearing a stiff and posteriorly recurved blackish hair; base broadly arcuate; eyes large and prominent, the tempora very short, the temporal angles feebly evident; antennæ long and very slender, fully one-half as long as the body, just visibly incrassate, the tenth joint on the compressed side nearly one-half longer than wide, the eleventh more than twice as long as wide. *Prothorax* much narrower than the head, longer than wide, the anterior lobe subglobular, very slightly wider than long, the posterior one-third the total length, strongly expanded to the distinct basal margin; surface finely, very remotely punctate, the punctures becoming close anteriorly and toward the middle except toward base; pubescence inconspicuous. *Elytra* large, very nearly twice as long as wide, twice as wide as the prothorax, slightly dilated behind the middle, thence gradually and feebly narrowed, the apex not very broadly rounded; transverse impression distinct, the post-scutellar broad and feeble; omoplates large and but slightly prominent; surface finely, rather sparsely punctate, the punctures becoming slightly more distinct and very feebly asperate toward base; pubescence fine, dark and not distinct posteriorly but coarse dense cinereous and conspicuous in the basal pale area, the hairs streaming obliquely outward in the impression, giving a sericeous appearance. *Abdomen* polished, sparsely pubescent. *Legs* rather long and distinctly stout throughout. Length 3.0 mm.; width 0.9 mm.

California (Lake Co.).

A fine species resembling *cursor* in general habitus, but differing in its larger size, more slender antennæ and narrower prothorax, with relatively shorter posterior lobe. The type is a male, having the fifth segment unmodified on the disk, but feebly subtruncate at apex, the genital segment broadly, feebly sinuato-

truncate throughout the width, with the lateral angles slightly acute and prominent.

4. **L. cursor** n. sp.—Moderately shining, dark rufo-testaceous, the abdomen, posterior three-fourths of the elytra and antennæ except toward base, black; basal fourth of the elytra more flavate. *Head* a little wider than long, moderately convex, finely but strongly, rather closely and asperately punctate, feebly pubescent, broadly arcuate and unimpressed at base; eyes large and prominent, the tempora short; temporal angles rather distinct; antennæ slender, feebly incrassate, one-half as long as the body, the tenth joint much longer than wide. *Prothorax* distinctly narrower than the head and longer than wide, the apical lobe broad, transversely oval, very abruptly limited by the constriction, the posterior occupying two-fifths of the total length, feebly and gradually expanded to the basal margin; collar rather narrow but distinct; surface strongly convex, finely evenly and closely punctate. *Elytra* nearly twice as long as wide, scarcely more than twice as wide as the prothorax, just visibly wider behind the middle than at base, thence feebly, gradually narrowed and not broadly rounded at apex; humeri widely exposed; post scutellar impression broad and feeble, the omoplates scarcely prominent; transverse impression at basal fifth broad and very pronounced; disk closely punctate, the punctures rather coarse toward base, minute but not more distant toward apex; pubescence fine short and close, rather dark in color and inconspicuous but becoming pale, coarser, denser and more conspicuous in the pale area at basal fourth. *Abdomen* polished, minutely, remotely punctate and sparsely pubescent. *Legs* long and slender. Length 2.9 mm.; width 0.85 mm.

Texas (El Paso); Arizona (Seligman and Peach Springs).

I took the single male type at El Paso some years ago, and the Arizona specimens, collected by Mr. Wickham, do not seem to differ, the male from Peach Springs being simply a little more sparsely punctate; two specimens, marked "Kansas," are also attached, as the differences presented are purely varietal. The male has the fifth ventral broadly rounded behind, becoming feebly subtruncate in the middle and unmodified on the disk, the genital segment broadly, feebly sinuato-truncate throughout the width.

The last joint of the maxillary palpi is very large and wide, with the outer side but little longer than the inner.

5. **L. alacer** n. sp.—Narrow, polished, pale rufo-testaceous, the abdomen, elytra in posterior two-thirds and antennæ except toward base, blackish. *Head* rather wider than long, moderately convex, minutely, sparsely punctate, broadly arcuate at base and unimpressed; eyes very large and prominent, the tempora short and convergent, merging by a feebly marked angle into the base; antennæ long and very slender, rather more than one-half as long as the

body, very feebly incrassate, the tenth joint much longer than wide. *Prothorax* much narrower than the head, slightly longer than wide, very convex, minutely and very sparsely punctate, the anterior lobe slightly transverse, the posterior strongly expanded to the well marked basal margin; pubescence inconspicuous. *Elytra* long, twice as long as wide, twice as wide as the prothorax, very slightly dilated behind the middle, thence gradually narrowed, the apex not very broadly rounded; humeri broadly exposed, the mes-episternum slightly visible from above as usual; disk broadly strongly and transversely impressed at basal fourth, the post-scutellar impression rather feeble, the omoplates large and moderately distinct; punctures fine and sparse, becoming relatively coarse, asperate and closer in the basal pale area; pubescence minute and very inconspicuous behind, but coarse, pale, closer and distinct toward base. *Abdomen* polished, minutely, remotely punctate, sparsely, somewhat coarsely pubescent. *Legs* moderate in length, the femora rather stout. Length 2.7 mm.; width 0.75 mm.

Utah (southwestern).

The sparse punctuation, narrower form and still longer, more slender antennæ, will prove sufficient to distinguish this fine species from the preceding, which it resembles in general facies. The single male in my cabinet has the fifth ventral rather broadly truncate at apex, but unmodified on the disk, the genital segment broadly, feebly sinuato-truncate throughout its width.

6. ***L. nubilatus*** n. sp.—Narrow, polished, pale rufo-testaceous, the abdomen, posterior parts of the elytra and antennæ except toward base, piceous-black. *Head* scarcely wider than long, a little less than semi-circularly rounded behind, the temporal angles slightly visible; eyes large, prominent; surface convex, finely, remotely punctate, the punctures becoming slightly asperate anteriorly; antennæ long, very slender, feebly incrassate, rather more than one-half as long as the body, the tenth joint much longer than wide. *Prothorax* rather small and narrow, much narrower than the head and decidedly elongate, strongly convex, the anterior lobe large, slightly wider than long, the posterior distinctly expanded toward base; punctures minute and very remote, except toward the median line before the middle and at apex, where they become much denser; pubescence inconspicuous. *Elytra* scarcely twice as long as wide, rather more than twice as wide as the prothorax, not perceptibly dilated behind the middle, abruptly, broadly rounded behind, the sides parallel; post-scutellar impression narrow and deep, the omoplates large and prominent; transverse impression broad and deep, punctures and pubescence minute, sparse and inconspicuous, except in the pale area at basal third or fourth, where they become coarser and denser, the former asperate. *Abdomen* polished, feebly pubescent. *Legs* long and slender. Length 2.65 mm.; width 0.7 mm.

Arizona.

This species, and the two preceding, are unusually closely allied among themselves, but *nubilatus* may be distinguished from both



by the greater extension of the head behind the eyes and parallel elytra, which are abruptly and broadly rounded at apex and not gradually narrowed behind the middle. From *cursor*, in addition, it may be known by its smaller size, much narrower form, narrower and less transverse anterior lobe of the prothorax and much sparser punctuation throughout, and, from *alacer*, by its narrower prothorax, with the punctures denser along the middle anteriorly, narrow and strong post-scutellar impression and several other characters. The sexual characters of the single male before me are nearly similar to those of *alacer*.

7. **L. lividus** n. sp.—Narrow, the elytra rather depressed, polished, pale rufo-testaceous, the abdomen except at base, the elytra behind the middle and the last five joints of the antennæ blackish; elytra frequently entirely pale. *Head* rather large, convex, minutely and very sparsely punctate, slightly wider than long, broadly arcuate at base; eyes large, prominent, the tempora very short, quite perceptibly angulate; antennæ scarcely one-half as long as the body, rapidly and strongly incrassate, the tenth joint scarcely as long as wide, obconical. *Prothorax* large, only slightly narrower than the head, slightly elongate, the anterior lobe transversely oval, the posterior about one-third of the total length, distinctly expanded to the basal margin; collar small and short; disk very convex, minutely and sparsely punctate throughout, the vestiture inconspicuous. *Elytra* about three-fourths longer than wide, scarcely more than two-thirds wider than the prothorax, quite distinctly dilated behind the middle, thence gradually narrowed to the apex, which is not very broadly subtruncate; humeri widely exposed but obliquely rounded at base; surface transversely and strongly impressed near the base, the post-scutellar impression distinct; omoplates moderately prominent; punctures fine, sparse, scarcely more distinct toward base, where the vestiture becomes more conspicuous but still rather sparse, the hairs tending to stream transversely outward in the transverse impression. *Abdomen* shining, the legs rather long and slender. Length 2.7–2.9 mm.; width 0.7–0.8 mm.

Texas (San Antonio).

The male has the fifth segment unmodified, feebly truncate at apex, the genital segment broadly and deeply sinuato-truncate throughout its width, the lateral angles rather prominent. This well marked species is represented by three specimens.

8. **L. sturmi** Laf.—Mon., p. 304; *elegans* || Laf.: l. c., p. 117; Lec.: Proc. Ac. Nat. Sci., Phila., 1852, p. 96 (*Anthicus*).

This very distinct species is amply described by LaFerté under the preoccupied name *elegans*. My two specimens were taken at Asheville, North Carolina. Length 2.7 mm.; width 0.75 mm.

The male has a strong internal and subprominent dilatation of the posterior tibiae just beyond the middle, the fifth ventral feebly subtruncate, with the surface slightly more finely reticulate and clothed with longer stiffer hairs toward the middle, and the genital segment, as usual, broadly sinuato-truncate. *Sturmi* is probably a somewhat local species and does not appear to be abundant.

9. ***L. nitidulus*** Lec.—Ann. Lye. Nat. Hist., N. Y., V., p. 153; Proc. Ac. Nat. Sci., Phila., 1852, p. 96 (*Anthicus*).

Moderately stout, polished, black throughout, the legs and base of the antennae scarcely paler, picescent. Head small, wider than long, broadly rounded behind from eye to eye, not impressed, the temporal angles just traceable; eyes rather large; surface finely, rather closely and asperately punctate; antennae not quite one-half as long as the body, incrassate, the tenth joint but slightly longer than wide. Prothorax large and convex transversely and longitudinally, very slightly narrower than the head, a little longer than wide, the anterior lobe transverse and with its widest point at its basal fourth; posterior lobe with its sides straight and just visibly divergent to the base; punctures fine and not dense. Elytra long, twice as long as wide, twice as wide as the prothorax, feebly dilated behind the middle, thence slightly narrowed to the apex, which is broadly, obtusely rounded; scutellar impression broad and distinct, the omoplates large and moderately prominent; transverse impression moderate; punctures fine, sparse, only slightly closer and more distinct toward base; pubescence sparse throughout, paler and coarser near the base but scarcely denser. Length 2.75 mm.; width 0.85 mm.

California. The male has feebly marked sexual characters, as in *cursor* and *alacer*. This description refers to the typical *nitidulus*, but among my large series from various parts of the State, it is easy to distinguish a number of more or less well marked varieties, some of them so marked that there can be but little doubt that there are several closely allied species included; they all agree, however, in having the head comparatively small and strongly, asperately punctate, and the anterior lobe of the prothorax widest near its base. Most of them have the basal parts of the elytra paler, the completely black forms, which may be regarded as typical, being rather rare. One specimen is from southwestern Utah.

10. **L. asperulus** n. sp.—Moderately stout and shining, dark rufo-testaceous, the elytra posteriorly, abdomen and antennæ, except near the base, blackish; legs pale. *Head* small, moderately convex, very strongly, closely and asperately punctate, broadly rounded behind, the temporal angles quite distinct; eyes rather large; antennæ less than one-half as long as the body, rather stout, incrassate, the tenth joint barely longer than wide. *Prothorax* only slightly narrower than the head, a little longer than wide, the anterior lobe transverse, strongly rounded and widest at about its basal third; basal lobe wide and large, with its sides straight and evenly, moderately divergent from the sharply angulate constriction to the basal margin, which is distinct and flat; surface convex, finely, rather sparsely punctate; pubescence not conspicuous. *Elytra* broad and rather short, scarcely more than two-thirds longer than wide, fully twice as wide as the head, slightly wider behind the middle than at base, broadly rounded behind; humeri very widely exposed; scutellar impression feeble, the omoplates moderately prominent; transverse impression distinct; punctures moderately close, conspicuous and asperate throughout the disk. *Abdomen* polished, sparsely pubescent, the legs moderate in length, with the femora rather stout. Length 2.6 mm.; width 0.85 mm.

Oregon (Portland).

The type of this species is unfortunately a female, but its elytra are much shorter than in any of the forms of *nitidulus* which I have seen, and the antennal joints are also much shorter. As it is unique, it is impossible to pronounce any definite opinion concerning the normality of the elytral asperities, and they may possibly be due to accident in this individual. I have, however, a good series collected in the Hoopa Val., Humboldt Co., Cal., which agree fairly well in form, color and structure with the Oregon type, but which have the elytra smooth; they may be regarded as conspecific until more individuals of the form selected for description can be obtained.

11. **L. canonicus** n. sp.—Narrow, polished, rufo-piceous, the abdomen and elytra black, the latter pale testaceous in basal third or fourth; legs and antennæ pale testaceous, the latter blackish toward apex. *Head* wider than long, moderately convex, strongly, asperately punctate, broadly rounded at base, the temporal angles short and feebly defined; eyes rather large and prominent; antennæ one-half as long as the body, slender, very feebly incrassate, the tenth joint on the compressed side at least one-third longer than wide. *Prothorax* much narrower than the head, elongate, very convex, minutely and sparsely punctate, the anterior lobe but slightly wider than long, widest very near its base, the sides thence circularly rounded to the distinct cylindrical collar; posterior lobe almost one-half of the total length, gradually expanded to the basal margin, with its sides somewhat sinuate. *Elytra* twice as long as wide and twice as wide as the prothorax, slightly dilated near the middle, feebly narrowed behind, the apex rather narrowly subtruncate; sub-

basal impression strong, the post-scutellar narrow and distinct, the omoplates rather prominent; punctures minute and very sparse even toward base; vestiture sparse throughout, coarser and cinereous toward base. *Abdomen* polished, sparsely pubescent, the legs long and slender. Length, 2.4–2.9 mm.; width 0.7–0.85 mm.

California (southern). Mr. H. C. Fall.

In the male the fifth ventral is unmodified, very broadly rounded behind, the genital segment as usual broadly, feebly sinuato-truncate. This species is allied to the two preceding, but differs from both in its much narrower form of body and more elongate and slender antennæ; from *nitidulus* it differs also in color, relatively much smaller and narrower prothorax, larger head and stronger subbasal impression of the elytra, and, from *asperulus*, in its very much sparser elytral punctures, among other features. Three specimens.

12. **L. ornatellus** n. sp.—Narrow, polished, black or blackish, the legs concolorous; antennæ testaceous toward base; elytra with the basal margin pale; pubescence fine and very sparse, dark in color and entirely inconspicuous, except in basal third of the elytra, where it becomes cinereous and coarser but not denser. *Head* about as long as wide, convex, minutely, remotely punctate, rounded at base, the tempora moderately long with obtusely rounded angles; eyes moderate in size, prominent; antennæ one-half as long as the body, moderately slender, very feebly incrassate, the tenth joint distinctly longer than wide, the eleventh as long as the preceding two in the male. *Prothorax* rather large, quite distinctly narrower than the head and longer than wide, strongly convex, minutely, remotely punctate throughout, the anterior lobe distinctly transverse, widest behind the middle, the posterior lobe two-fifths of the total length, with the sides feebly divergent and straight to the base; margin flat, the collar wide and distinct. *Elytra* not quite twice as long as wide, two-thirds wider than the prothorax, slightly dilated behind the middle, the sides thence distinctly convergent to the narrowly subtruncate apex; scutellar impression broad, the omoplates large and distinct, the transverse impression subobsolete; punctures minute and sparse throughout, only slightly more distinct toward base. *Abdomen* polished; sparsely pubescent, the legs slender. Length 2.4 mm.; width 0.7 mm.

Arizona (near the Grand Cañon). Dr. Prudden.

The male has the fifth ventral broadly and just visibly sinuate at apex, the genital segment feebly sinuato-truncate. Three specimens.

This is the only bicolored species which has the pale area of the elytra confined to the base, and not extending behind the omoplates.

13. **L. vividus** n. sp.—Narrow, polished, pale flavo-testaceous, the abdomen fuscous; elytra in posterior two-thirds piceous or blackish; antennæ black except toward base. *Head* fully as long as wide, minutely, very remotely punctate, rather strongly rounded behind, the temporal angles very obtuse and scarcely distinguishable; eyes moderately large, prominent; antennæ rather short and somewhat stout, longer than the head and prothorax, the tenth joint slightly longer than wide. *Prothorax* distinctly narrower than the head and longer than wide, minutely, remotely punctate throughout, the anterior lobe slightly transverse, widest a little behind the middle, the collar rather narrow but distinct; posterior lobe gradually dilated to the base, about one-third of the total length; pubescence inconspicuous. *Elytra* four-fifths longer than wide and twice as wide as the prothorax, quite distinctly dilated behind the middle, moderately broadly subtruncate at apex; humeri only moderately exposed at base; omoplates slightly prominent; transverse impression almost completely obsolete; punctures minute and sparse, becoming notably stronger and closer in the basal pale area; pubescence fine and inconspicuous, coarser and cinereous but scarcely at all denser in basal third. *Abdomen* polished, sparsely pubescent, the legs slender. Length 2.2 mm.; width 0.65 mm.

Arizona (Tucson and Pinal Mts.).

The four specimens before me are females and represent a well defined, small and very delicate species, not closely allied to any other here described.

14. **L. bipartitus** n. sp.—Subparallel, the elytra rather depressed, polished throughout, pale flavo-testaceous, the abdomen except at base and elytra, abruptly in posterior three-fifths, blackish; antennæ gradually fuscous toward apex. *Head* but very slightly wider than long, convex, minutely and remotely punctate, transversely rounded at base, the temporal angles well-marked though obtusely rounded; eyes rather large and prominent; antennæ moderately slender, fully one-half as long as the body, the outer joints just visibly thicker, the tenth distinctly elongate. *Prothorax* large and thick, convex, slightly narrower than the head and a little longer than wide, minutely, evenly and not very sparsely punctate; anterior lobe somewhat transverse, oval, large, widest near the middle, the posterior lobe rather short and wide, parallel; lateral constriction not extending at all obliquely upon the disk. *Elytra* three-fourths longer than wide, very nearly twice as wide as the prothorax, the sides almost perfectly parallel and nearly straight; apex somewhat abruptly and broadly truncate; omoplates broad and feeble; surface finely, sparsely punctate, the punctures but slightly more distinct and not closer toward base, where the pubescence is slightly more distinct especially along the flanks. *Abdomen* sparsely, rather coarsely pubescent, the legs slender. Length 2.4 mm.; width 0.75 mm.

California (Yuma). Mr. Wickham.

The only species with which this peculiar form could be con-

founded is *turgidicollis*, and from that it can be at once separated by its elongate antennæ and much more convex head, besides elytral coloration. It is represented by a single female specimen.

15. **L. turgidicollis** n. sp.—Narrow, the elytra rather flat, polished, pale testaceous, the elytra throughout, abdomen except at base, and antennæ toward apex, more or less dark piceous or blackish. *Head* rather longer than wide, finely, sparsely punctate, the front flattened or even slightly concave toward the median line and more densely reticulate; base transversely arcuate, the tempora subparallel and nearly as long as the eyes, which are moderately large, prominent and distinctly setose; antennæ very stout, feebly incrassate, about as long as the head and prothorax, the tenth joint not at all longer than wide. *Prothorax* large, very convex, finely, evenly and rather sparsely punctate, only slightly narrower than the head, though much longer than wide, the anterior lobe large, globular, not transverse, the basal lobe rather short, dilated to the base; constriction not extending obliquely upon the disk; pubescence scarcely distinct. *Elytra* three-fourths longer than wide, barely twice as wide as the prothorax, parallel and nearly straight at the sides, the apex rather abruptly, broadly subtruncate; disk even, the omoplates rather small and moderately developed; punctures fine and moderately sparse, becoming subobsolete toward apex; vestiture only slightly more distinct toward base. *Abdomen* finely punctulate, not very remotely pubescent, the legs slender. Length 2.4 mm.; width 0.7 mm.

California (southern). Mr. Dunn.

The parallel, even and slightly flattened elytra, large prothorax, depressed front and elongate parallel tempora, will enable the student to identify this singular species, and the latter character will also distinguish it from *bipartitus*, in addition to the characters given under that heading. It is represented by a single female example.

16. **L. subtilis** n. sp.—Narrow, shining, dark piceous-brown throughout, the head and prothorax a little more rufous; legs concolorous; antennæ black, pale flavo-testaceous toward base. *Head* orbicular, scarcely wider than long, convex, finely, sparsely punctate; eyes moderately large, convex, the tempora convergent and rounded behind them for a considerable distance, the base transversely arcuate, the angles very obtuse, feebly traceable; antennæ about one-half as long as the body, quite distinctly and very gradually incrassate, the tenth joint slightly longer than wide. *Prothorax* moderate in size, much narrower than the head and slightly elongate, convex, finely sparsely punctate, the anterior lobe distinctly wider than long, oval, widest near the middle, the posterior fully one-third of the total length, of moderate width, gradually and distinctly expanded to the basal margin. *Elytra* three-fourths longer than wide, fully twice as wide as the prothorax, the sides parallel, feebly arcuate behind, the apex moderately broadly truncate; disk

nearly even, the omoplates large, moderately prominent, slightly oblique; punctures fine and sparse throughout, the pubescence short but rather coarse and distinct over the entire surface. *Abdomen* polished, sparsely pubescent, the legs moderate in length, slender. Length 2.1 mm.; width 0.65 mm.

New Mexico (Gallup). Mr. Wickham.

A small delicate species of piceous color, represented in my cabinet by two perfectly similar females. The elytra are scarcely as abruptly truncate at apex as in *turgidicollis*, but very much more so than in *animatus*.

17. **L. animatus** n. sp.—Slender, rather convex, shining; hind body above and beneath black throughout, the head, prothorax, legs and basal parts of the antennæ rufo-piceous. *Head* fully as long as wide, convex, finely, rather sparsely, subasperately punctate, the punctures mingled with short feeble reticulations, transversely rounded at base, the tempora parallel and much shorter than the eyes, which are moderately large and prominent; temporal angles rather pronounced; antennæ somewhat thick and strongly incrassate, not quite one-half as long as the body, the tenth joint not longer than wide. *Prothorax* quite distinctly narrower than the head and elongate, strongly convex, finely, evenly and somewhat closely punctate, the punctures subasperate toward apex; anterior lobe large, not wider than long, widest near the base, the sides thence circularly rounded to the collar; posterior lobe rather less than one-third of the total length and relatively somewhat wide, expanded feebly to the base; disk with a short impressed median line near the base. *Elytra* long, twice as long as wide, not quite twice as wide as the prothorax, scarcely visibly wider at the middle, but thence obliquely narrowed to the apex, which is narrowly subtruncate; omoplates feeble; punctures fine and rather close, the pubescence fine, gradually less visible toward apex. *Abdomen* narrow, elongate and gradually narrowed, polished, the legs rather long and slender. Length 2.3 mm.; width 0.6 mm.

Arizona (Benson). Mr. Dunn.

The male has the apex of the fifth ventral broadly and feebly sinuate, the disk not modified, the genital segment deeply sinuato-truncate throughout its width, with the angles rather obtusely prominent and the hind tibiæ gradually narrowed internally toward base. Two specimens.

18. **L. solivagans** n. sp.—Narrow and elongate, moderately convex, rather dull, black, the head, prothorax and antennæ, except toward apex, dark rufo-piceous. *Head* slightly wider than long, convex, rather finely and sparsely, but strongly and subasperately punctate, transversely rounded at base, the tempora short and convergent around the distinctly traceable basal angles; eyes moderately large, prominent; antennæ slender, very feebly incrassate, about one-half as long as the body, the tenth joint much longer than wide. *Prothorax* subequal in width to the head, not longer than wide, convex,

strongly, somewhat densely punctate, the anterior lobe very large, strongly transverse, oval, widest at about the middle, the basal lobe rather short, nearly cylindrical, the constriction not extending at all upon the disk. *Elytra* long, about twice as long as wide, not more than two-thirds wider than the prothorax, just visibly dilated at the middle, the sides thence feebly oblique to the apex, which is moderately widely subtruncate; omoplates very feeble; punctures strong and dense toward base, becoming gradually very fine and moderately distant toward apex; pubescence short, somewhat abruptly cinereous and more distinct in basal third. *Abdomen* moderately shining, the legs rather short and thick. Length 2.5 mm.; width 0.75 mm.

Arizona.

The unique male has the fifth ventral broadly truncate toward the middle, the genital segment deeply sinuato-truncate, the tibiae not distinctly modified. This species is very distinct, and, together with *bipartitus* and *turgidicollis*, is somewhat aberrant in the outline and constriction of the prothorax.

19. **L. gibbithorax** Pic—Miscel. Ent., March, 1894, p. 21 (Anthicus).

Moderately elongate, shining, reddish-testaceous, with the abdomen and posterior two-thirds of the elytra blackish, the head dark, arcuately rounded behind, with the punctuation sparse; eyes gray; last joint of the palpi enlarged; antennae slender, rather long, almost filiform, sometimes darker toward apex. Prothorax relatively short, somewhat dilated, rounded anteriorly, having near the base a gibbous elevation which is very distinct in profile; base transversely grooved. Elytra scarcely narrowed at base, the humeri somewhat angulate, distinctly attenuate behind, the apex truncate, somewhat dilated at the middle, with the punctuation very fine, having some pale hairs which are short, sparse and semi-erect. Under surface shining. Legs slender, moderately short, the posterior tibiae slender, the femora scarcely thickened. Length 3.0 mm.

Texas. I have not seen the type of *gibbithorax*, but Mr. Pic has kindly sent me a specimen of the closely allied *backianus* Chmp., from Mexico. The erect hairs mentioned in the description are very short and only distinct toward apex, as usual in this genus. This species differs from *backianus* and *tumidicollis* in its coloration and rather stouter form. The above description is translated from the original.



**THICANUS** n. gen.

The few closely allied species forming this generic group are somewhat intermediate between *Lappus* and *Anthicus*, but evidently cannot be associated with the former because of their much shorter antennæ and small fourth joint of the maxillary palpi, which has the form of a right-angled triangle, and, from *Anthicus*, they differ in the lateral oblique extension of the mesosternum; from both of these genera they differ conspicuously in the form of the prothorax. Those known to me may be mutually separated as follows:—

Head evenly and almost circularly rounded behind the eyes.

Antennæ rather strongly but gradually clavate, the penultimate joints transverse.

Punctures of the elytra rather close-set, especially toward the suture, those of the pronotum very densely crowded toward base..1. **texanus**

Punctures of the elytra rather coarser and decidedly more distant, those of the pronotum moderately dense toward base; size a little larger.

2. **rejectus**

Antennæ more slender, very feebly enlarged toward apex, the penultimate joint rather longer than wide.....3. **mimus**

Head prominent in the middle at base and rather narrowly rounded, the sides thence very oblique for some distance, then rounded to the eyes. Pacific coast.

Head sparsely punctate; genital segment of the male feebly sinuate in arc at the middle, (*annectens* Lec.).....4. **californicus**

Head densely punctate; genital segment angularly and deeply emarginate at apex .....5. **franciscanus**

The species of this genus resemble each other in general habitus and color to an extreme degree, and if it were not for the readily observable modifications of the sexual apparatus, it would frequently be impossible to pronounce any definite opinion as to their true status. In all of them there can be observed two feeble transverse and very vague elevations near the basal margin of the pronotum.

The intromittent apparatus of the male is very simple in structure, when compared with the homologous parts in *Malporus*.

1. **T. texanus** Laf.—Mon., p. 301 (*Anthicus*).

Highly polished throughout, without trace of reticulation, sparsely but strongly punctate, the pubescence short and rather coarse but sparse, without trace of erect setæ; elytra clouded

with black at apex and near the scutellum, each having in addition a large suffused black cloud at the middle. Prothorax as wide as the head, densely punctate toward base. Length 2.1–2.7 mm.; width 0.7–0.8 mm.

The large series before me is from Galveston, Texas, and represents without much doubt the true *texanus* of LaFerté, which was unknown to LeConte.

In the present species, which has been fully and accurately described by LaFerté, the male has the fifth ventral but slightly longer than the fourth, broadly rounded at apex, just visibly sinuato-truncate for a short distance in the middle, with the adjoining surface feebly, transversely impressed, the genital segment very feebly sinuate at tip, with the surface feebly and transversely impressed. The male intromittent organ consists of a superior corneous flattened and very shallow sheath, nearly one-half as long as the abdomen, the short basal part of which is parallel at the sides, the remainder very elongate, bent downward, with the sides straight and gradually convergent throughout to the apex, the latter slightly dilated in the form of a small flattened sub-circular button. The intromittent duct proper is partially enclosed along the under surface of the sheath; it is membranous or feebly coriaceous in structure, and fully as long as the protective sheath, from which it can be bent downward; it is somewhat distorted in the specimen examined but appears to be of a sub-cylindrical form.

2. **T. rejectus** Lec.—Proc. Ac. Nat. Sci., Phila., 1852, p. 97 (Anthicus).

Moderately stout, highly polished throughout above, dark rufo-testaceous, the anterior parts frequently picescent; elytra colored as in *texanus*. Head convex, rather longer than wide, finely, sparsely but distinctly punctate, semi-circularly rounded behind, the eyes rather large and prominent, with extremely short setæ as usual. Prothorax scarcely as wide as the head, not longer than wide, convex, acutely constricted rather behind basal third, finely but strongly, sparsely punctate, the punctures closer toward base. Elytra barely three-fourths longer than wide, twice as wide as the prothorax, quite distinctly wider at the middle than at base, the apex rather broadly rounded; punctures coarse and sparse, finer and with the surface duller toward apex. Abdomen finely granulato-reticulate but somewhat shining. Legs rather short and thick. Length 2.5–2.75 mm.; width 0.7–0.85 mm.

Sea-beaches of New Jersey and Delaware. This species very greatly resembles *texanus*, but is rather larger and with more distant punctures, those toward the base of the pronotum especially being less densely crowded. An essential similarity of the sexual characters is assumed, as there is no specimen before me which is in condition for observation in this regard.

The eastern examples, previously regarded by me as belonging to *Anth. californicus*, are to be referred to the present species, the resemblances throughout the genus being very great, as before remarked.

3. **T. minimus** n. sp.—Moderately slender, highly polished, pale rufo-testaceous, the legs and antennæ throughout pale; abdomen black; elytra blackish at apex, and with a large blackish cloud at the middle of each. *Head* about as long as wide, convex, evenly rounded behind, finely but strongly, rather sparsely punctate, the eyes moderately large, prominent; antennæ very nearly as long as the head and prothorax, slender, only very feebly incrassate, the penultimate joint rather longer than wide. *Prothorax* scarcely as wide as the head, rather longer than wide, moderately convex, finely but strongly punctate, the punctures rather dense toward the median line especially toward base, the basal tubercles distinct; anterior lobe widest and strongly rounded near the apex, the posterior rather less than one-third the total length; constriction acute. *Elytra* three-fourths longer than wide, somewhat less than twice as wide as the prothorax, decidedly wider a little behind the middle than at base, the apex moderately broadly rounded and oblique, the sutural angles slightly rounded; disk rather coarsely punctate, the punctures somewhat close toward the suture; omoplates small but quite distinct; pubescence short but stiff, sparse but pale throughout and distinct. *Abdomen* moderately shining, the legs rather slender. Length 2.4–2.75 mm.; width 0.75–0.8 mm.

Wyoming (Cheyenne); New Mexico (Coolidge).

The male has the fifth ventral but little longer than the fourth, with a large rounded discal impression which is more shining than the general surface, the genital segment broadly impressed throughout the width, and with the apex arcuately but rather strongly sinuate in the middle; terminal knob of the gradually narrowed copulatory sheath transversely expanded, with the lateral extremities posteriorly hooked.

4. **T. californicus** Laf.—Mon., p. 128; Lec.: Proc. Acad. Nat. Sci., Phila., 1852, p. 97; *annectens* Lec.: l. c. (*Anthicus*).

Polished, rufo-testaceous, the head blackish; elytra clouded with black except toward base and narrowly along the suture, varying to entirely black. Head finely but strongly, sparsely

punctate, the eyes prominent; antennæ slender, scarcely as long as the head and prothorax, feebly thickened toward apex, the penultimate joint fully as long as wide, the last short, second and third equal and but slightly shorter than the first which is thicker. Prothorax not quite as wide as the head, a little longer than wide, acutely constricted somewhat behind basal third, the punctures fine and very sparse except toward base, where they become coarse and very dense, the two transverse tubercles more or less distinct, the surface before them apparently somewhat impressed. Elytra elongate, very nearly twice as long as wide, twice as wide as the prothorax, quite distinctly wider at the middle, the punctures coarse and sparse; pubescence sparse, short, pale throughout. Length 2.5–2.8 mm.; width 0.8–0.9 mm.

California seacoast from San Diego to San Francisco. The apex of the abdomen is generally pale, and, in the male, the fifth segment is distinctly longer than the fourth, rounded and not at all truncate at apex, with the surface very obsoletely and broadly impressed along the middle, and gradually just visibly reflexed toward tip, the genital segment with a small feeble and circularly rounded apical sinuation, and a transverse discal impression, the apical edge fringed with stiff hairs.

In this species the male intromittent organ is quite different from that of *texanus* and *mimus*; it is not quite so long, and the dorsal corneous sheath has the sides nearly straight and feebly convergent from the base almost to the apex, where it becomes abruptly narrowed and very feebly bent downward, the narrow ligula short, subparallel, obtuse but not distinctly enlarged at apex. The intromittent duct proper, lying beneath the sheath, is slender, simple, coriaceous and extends slightly beyond the apex of the sheath.

5. **T. franciscanus** n. sp.—Moderately stout, convex, shining, pale rufo-testaceous, the entire under surface of the hind body, and a moderately large cloud near the middle of each elytron, black; antennæ and legs pale throughout. *Head* rather longer than wide, convex, strongly and rather closely punctate; eyes moderately large, prominent, situated somewhat before the middle of the medial length; antennæ somewhat stout, distinctly incrassate, scarcely as long as the head and prothorax, the tenth joint about as long as wide. *Prothorax* ample, not distinctly narrower than the head, a little longer than wide, rather feebly convex toward the middle, finely but strongly punctate, the punctures somewhat sparse anteriorly but becoming dense toward base, the two basal tubercles distinct; pubescence inconspicuous; an-

terior lobe large, transverse, widest at its anterior third, the sides convergent and rounded to the acute constriction; posterior lobe distinctly less than one-third the total length, rapidly expanded to the basal margin. *Elytra* nearly twice as long as wide, twice as wide as the prothorax, distinctly wider at the middle than at base or apex, the latter subequal, the apex broadly arcuate; humeri broadly exposed at base, the mes-episternum not at all visible from above; punctures coarse and sparse, rather closer and finer toward the suture; pubescence short and stiff, sparse but pale and distinct throughout. *Abdomen* alutaceous, finely pubescent. *Legs* moderate in length and rather stout. Length 3.1 mm.; width 0.95 mm.

California (near San Francisco).

The single male before me indicates a species which is appreciably larger than *californicus*, and the sexual characters are quite different. The fifth ventral is short and but slightly longer than the fourth, its apex broadly, just visibly sinuate, and its disk unmodified; genital segment deeply, angularly emarginate in the middle at apex, the emargination but slightly more than twice as wide as deep, the disk with a large deep and transversely oval impression, and the posterior edge fringed with stiff, inwardly directed cilia. In this specimen the extreme tip only of the copulatory sheath is exposed, but this is much broader and more obtuse than in *californicus*, and there is, in addition, a slender thin fillet at each side of the sheath-apex, of which I can find no homologue whatever in that species.

#### VACUSUS n. gen.

The members of this genus are small, narrow and usually polished, sparsely punctate and pubescent species, of peculiar facies, but not unremindful of some of the various forms of *Anthicus*. They also resemble *Anthicus* in antennal, oral and crural structure, but differ completely in the entire conformation of the mesosternum, as detailed in the table of genera. They present three types, quite distinct in appearance and environment, represented by *lætus*, *nigritulus* and *formicetorum*, the first inhabiting the Southern States from Florida to southern California, the second peculiar to the true Pacific coast fauna, and the third to the desert regions of the Sonoran province. The latter is remarkable, in addition to its peculiarities of facies, in that its closely allied components are myrmecophilous in habit, the symbiosis however probably not being complete.

The species may be separated as follows:—

Prothorax rounded at the sides anteriorly, thence straight and oblique to the basal margin.

Head simply and very remotely punctate; elytral pubescence very short and rather closely decumbent.

Prothorax always pale, rufous.

Elytra with a basal, median, and apical black fascia, varying to almost entirely black, the basal fascia obsolete in the paler forms.

**1. lætus**

Elytra pale, each with a median discal spot of black; punctuation very much closer.....2. **supplex**

Prothorax black or piceous-black.

Abdomen minutely and rather densely punctate throughout; elytral punctures sparse .....3. **monitor**

Abdomen less minutely and very remotely punctate toward base; elytra less sparsely punctured, the prothorax more elongate.

**4. confinis**

Head with longitudinal and vermiculate scratches intermingled with the sparse punctures; elytra with longer, coarser, more erect and conspicuous pubescence; body black, the elytra sometimes paler.

Black throughout, the head and pronotum not impressed.

**5. nigrutilus**

Black, the elytra piceous-brown and relatively longer and larger; occiput impressed in the middle at base; pronotum impressed along the median line toward base.....6. **arcanus**

Prothorax angulate at the sides anteriorly, oblique and broadly sinuate thence to the base; smaller, pubescent species.

Head finely and very remotely punctate; elytra each with three or four series of long stiff erect setæ.

Elytra parallel and fully three-fourths longer than wide.

**7. desertorum**

Elytra much shorter, scarcely more than one-half longer than wide; eyes a little larger; pronotal punctures decidedly less dense.

**8. prominens**

Head more coarsely and subrugosely, though not densely, punctate, and more plentifully pubescent.

Body slender, flavate throughout, the elytral setæ distinct but very sparse; humeri less broadly exposed at base .....9. **formicetorum**

Body stouter, the elytra more broadly truncate at base, with the setæ not evident on the disk, the suture and apex feebly clouded with a blackish tint.....10. **suspectus**

The species of each of the three groups are rather closely allied among themselves, but, as far as it is possible to judge, are distinct as above defined.

1. **V. lætus** Laf.—Mon., p. 157; *vicinus*, *thoracicus* Laf.: l. c., pp. 157, 158; *bizonatus* Laf. (*bifasciatus* || Say): l. c., p. 274; *fulvomicans* Qued.: B. Ent. Z., XXX, (1886,) p. 123 (*Anthicus*).

Narrow, polished, minutely, sparsely pubescent, pale rufo-testaceous, the head darker and the elytra with a median band, transverse apical and frequently obsolete basal area, of black. Head and pronotum minutely, remotely punctate, the latter scarcely visibly longer than wide, equal in width to the head, almost globularly convex, the sides convergent and straight behind to the slightly tumid basal margin. Elytra not quite twice as long as wide and less than twice as wide as the prothorax, subparallel, strongly but remotely punctate, the scutellar impression distinct. Legs and under surface ferruginous. Length 2.3–2.6 mm.; width 0.7–0.8 mm.

This well known species is distributed through the Southern States bordering the Gulf of Mexico. It is sufficiently constant in form and structure, but varies considerably in color. In the darker form, named *thoracicus* by LaFerté, the elytra are almost black; they are never entirely black, however, for upon close inspection in a good light, there will always be seen a narrow line along the suture and a fine transverse fascia at basal fourth and apical third of reddish tinge. The prothorax is always red. I am disposed to agree with LaFerté in considering *bifasciatus* Say, as allied to *lætus*, and not to *cervinus*, as conjectured by LeConte.

2. **V. supplex** n. sp.—Moderately stout, polished, pale rufo-testaceous throughout, with exception of a small subtransverse cloud-like spot at the middle of each elytron which is of black. *Head* subquadrate, convex, finely but distinctly punctate anteriorly, minutely and very remotely so toward the truncate base, which is feebly impressed in the middle; eyes well developed, fully as long as the subparallel tempora, and more prominent; antennæ short, incrassate, as long as the head and prothorax, the penultimate joints transverse. *Prothorax* not longer than wide, the sides broadly rounded anteriorly to the distinct collar, convergent and straight posteriorly to the basal margin, which is very feebly swollen; surface evenly convex, minutely, remotely punctate anteriorly, more coarsely and closely so toward base; pubescence minute, decumbent, with some widely dispersed erect bristles. *Elytra* three-fourths longer than wide, nearly twice as wide as the prothorax, feebly dilated behind, broadly, obtusely rounded at apex; humeri broadly exposed, broadly rounded at base, narrowly so externally; disk coarsely, rather closely punctate; finely and sparsely so toward apex, feebly impressed on each side of the suture at base; pubescence short and decumbent but coarse and distinct. *Abdomen*

minutely, very densely punctate and pubescent, more sparsely so in the middle at base. Length 2.6 mm.; width 0.85 mm.

Arizona (Tuçson).

Differs from *lætus* in its stouter form, shorter prothorax, much denser and more conspicuous punctuation and pubescence and in coloration. It is represented by a single specimen which I took some years ago at the locality indicated.

3. **V. monitor** n. sp.—Narrow, highly polished, black, the pronotum feebly picescent toward base, the elytral suture very finely rufescent; antennæ fuscous; under surface and femora blackish, the tibiæ and tarsi paler. *Head* subquadrate, finely, remotely punctate, the punctures uneven in distribution and unequal in size; eyes rather small, shorter than the tempora; base broadly arcuato-truncate and unimpressed; antennæ barely as long as the head and prothorax, feebly incrassate, the penultimate joints scarcely as long as wide. *Prothorax* equal in width to the head and similarly punctate, the punctures a little more distinct toward base, just visibly longer than wide; sides broadly arcuate anteriorly, straight and oblique behind to the basal margin, which is distinctly tumid; collar short; surface strongly, evenly convex. *Elytra* three-fourths longer than wide, not quite twice as wide as the prothorax, very feebly dilated behind the middle, thence obliquely and gradually narrowed to the apex, which is conjointly rather narrowly rounded; disk feebly impressed at the scutellum, narrowly canaliculate at each side of the suture in apical third or fourth, strongly but very sparsely punctate, the punctures becoming minute behind; humeri broadly exposed, rounded. *Abdomen* minutely, densely punctate, reticulate and pubescent. *Legs* rather short, the femora distinctly incrassate. Length 2.3 mm.; width 0.65 mm.

Louisiana (Morgan City); Texas (Galveston).

This species is allied rather closely to *lætus*, but differs in its smaller size, narrower form, black prothorax and elytra, and in the male sexual characters. The vestiture of the upper surface is similar to that of *lætus*, the elytral hairs very short but rather coarse and becoming still smaller toward apex.

In this section of the genus the genital or sixth segment is peculiarly modified, the median emargination of *Anthicus* becoming a deep cleft, the two lobes thickened and bent strongly downward, the tips inflexed and individually emarginate; the intromittent organ is extremely slender and elongate, finely channeled beneath, the apex gradually finely acuminate and slender, and bent downward. In the present species merely the tip is abruptly and feebly bent downward, while in *lætus* the spicule is gradually curved. In *lætus* the fifth ventral of the male is broadly rounded behind, with its surface minutely, densely granulato-reticulate



and much duller than the other segments, while in *monitor* this segment is more narrowly rounded and does not differ in sculpture or lustre.

4. **V. confinis** Lec.—Ann. Lyc., N. Y., V., p. 153.; Proc. Ac. Nat. Sci., Phila., 1852, p. 98 (*Anthicus*).

Narrow, highly polished, black throughout, the under surface and legs frequently paler. Head subquadrate, rather longer than wide, very minutely punctate, the punctures very sparse anteriorly and extremely remote toward base, the latter broadly arcuato-truncate and not impressed; eyes somewhat large, fully as long as the tempora and more prominent; antennæ rather slender, noticeably incrassate, scarcely as long as the head and prothorax, the penultimate joints not quite as long as wide. Prothorax quite distinctly longer than wide, the sides strongly rounded anteriorly, oblique and straight thence to the basal margin, which is distinctly swollen; surface convex, finely, very remotely punctate, the punctures becoming a little more distinct, but scarcely more numerous, toward base; vestiture not distinct. Elytra less than twice as long as wide, twice as wide as the prothorax, just visibly dilated behind the middle and thence gradually narrowed to the apex, which is not very broadly rounded; disk slightly impressed on the suture behind the scutellum, coarsely, deeply and rather closely punctate, the punctures impressed, becoming fine toward apex; pubescence extremely minute and decumbent. Abdomen finely reticulate, shining, minutely, sparsely punctate and rather sparsely pubescent. Length 2.3–2.6 mm.; width 0.6–0.75 mm.

Texas to southern California. A very abundant species, readily distinguishable from *lætus* by its narrower form, narrower and less globular prothorax and denser punctuation; the vestiture is even shorter and more minute than in that species. The upper surface is invariably black throughout, but I have before me a small specimen from Texas, which is entirely pale flavate and translucent, apparently very immature, except that the integuments are not distorted in drying.

5. **V. nigritulus** Lec.—Ann. Lyc. N. Y., V, p. 154; Proc. Ac. Nat. Sci., Phila., 1852, p. 101 (*Anthicus*).

Black, highly polished; antennæ toward base and legs throughout dark brown; pubescence sparse but long, coarse and distinct,

intermingled with erect stiff setæ. Head convex, subquadrate, finely, remotely punctate, the eyes moderate, not as long as the tempora; base broadly arcuato-truncate, not impressed; antennæ a little longer than the head and prothorax, incrassate, the outer joints as long as wide. Prothorax as long and wide as the head, apparently a little longer than wide, rather strongly rounded at the sides anteriorly, thence strongly oblique and straight to the distinctly swollen basal margin; disk evenly convex, finely and sparsely punctate, the interspaces even and highly polished. Elytra barely two-thirds longer than wide, about twice as wide as the prothorax, scarcely one-third longer than the head and prothorax combined, parallel, broadly, obtusely rounded behind, the humeri broadly exposed, transverse near the prothorax; disk very obsoletely impressed at the scutellum, coarsely and strongly but not densely punctate. Abdomen minutely, densely punctate and pubescent. Length 2.4 mm.; width 0.7 mm.

California (Humboldt Co. to San Francisco). This is an abundant species, represented by a large series in my cabinet. A series of seven specimens, all that I obtained in the Hoopa Valley, Humboldt Co., are pale ochreous-flavate throughout, otherwise agreeing in every particular with the ordinary black form which also seems to be very constant in coloration.

In this section of the genus as represented by the present species, the genital segment of the male is less elaborately modified than in *lætus*, the two lobes being flattened, gradually acuminate and bent downward, the tips abruptly and minutely inflexed; the intromittent organ is very slender but shorter, feebly swollen toward apex and then gradually, finely acuminate and scarcely perceptibly bent downward.

6. **V. arcanus** n. sp.—Shining, black, the elytra, legs and basal parts of the antennæ dark red-brown; pubescence coarse, semi-erect, sparse but conspicuous. Head quadrate, convex, truncate and impressed at base, finely, sparsely punctate, the eyes rather small, much shorter than the tempora, the latter parallel; antennæ moderately stout, about as long as the head and prothorax, distinctly incrassate, the penultimate joints fully as long as wide. Prothorax as long but scarcely as wide as the head, apparently a little longer than wide, rounded on the sides anteriorly, straight and oblique from anterior third to the tumid basal margin; disk convex, feebly impressed and with scratch-like sculpture in the middle toward base, strongly evenly and not very sparsely punctate. Elytra three-fourths longer than wide, very much longer than the head and prothorax and about twice as wide as the latter, just visibly

dilated behind the middle, thence feebly narrowed, the apex rather broadly rounded; humeri very broadly rounded; scutellar impression strong, the humeral feeble; omoplates prominent; disk coarsely, deeply, rather sparsely punctate. *Abdomen* finely, closely pubescent, coarsely reticulate and extremely minutely punctulate. *Legs* rather short and stout. Length 2.5 mm.; width 0.75 mm.

Washington State (Yakima.) Mr. Wickham.

The sexual characters of the single male before me are similar to those of *nigritulus*, but this species may be readily distinguished by the larger, longer elytra, impressed occiput and pronotum and stronger, denser punctuation of the latter.

7. **V. desertorum** n. sp.—Narrow, subparallel and rather depressed, polished, dark brownish-testaceous throughout, the pubescence coarse, suberect and rather abundant, very remote on the head. *Head* subquadrate, moderately convex, broadly arcuato-truncate at base, minutely and remotely punctate throughout, the eyes rather small, much shorter than the tempora, the latter parallel; antennae a little longer than the head and prothorax, somewhat thick, moderately incrassate, the penultimate joints quadrate. *Prothorax* scarcely as long as wide, rather wider than the head, angulate and prominent laterally at apical third, the sides thence broadly arcuate to the short but distinct collar, and broadly sinuate and convergent to the feebly tumid basal margin; disk convex anteriorly, finely, rather closely punctate, the punctures asperate toward apex. *Elytra* parallel and straight at the sides, broadly, abruptly obtuse at apex, three-fourths longer than wide and scarcely two-thirds wider than the prothorax; scutellar impression feeble; humeri widely exposed at base; disk rather coarsely and densely punctate, feebly rugulose by anteriorly oblique light. *Abdomen* feebly shining, pubescent, coarsely imbricato-reticulate, very minutely, sparsely punctulate. *Legs* moderate in length and somewhat slender. Length 2.25 mm.; width 0.65 mm.

Arizona (Holbrook). Mr. Wickham.

The modifications of the genital segment in the males of this group are nearly similar to those of *lætus*, but the lobes are shorter and mutually more distant. The present species is represented in my cabinet by two specimens, and the description is drawn from the male.

8. **V. prominens** n. sp.—Narrow, shining, pale brownish-testaceous, the vestiture coarse, moderate in length, rather abundant and conspicuous, very sparse on the head, the elytra with erect bristles seriatly arranged. *Head* quadrate, somewhat convex, minutely and very remotely punctate throughout, the base arcuato-truncate; eyes moderate, slightly shorter than the tempora; antennae distinctly longer than the head and prothorax, gradually and rather strongly incrassate, the penultimate joints quadrate. *Prothorax* barely as long as wide, fully as wide as the head, prominent and angulate at the sides at apical third, thence broadly, semi-circularly rounded at apex with the

collar narrow but distinct, sinuate immediately behind the lateral prominence, and thence oblique and straight to the narrow and very slightly tumid basal margin; surface convex, shining, finely and sparsely punctate throughout. *Elytra* scarcely more than one-half longer than wide, distinctly less than twice as wide as the prothorax, a little wider at apical third than at base, broadly, obtusely rounded behind, the humeri broadly exposed and rounded at base; disk scarcely visibly impressed at the scutellum, feebly rugulose, not very coarsely but closely and strongly punctate, strongly shining. *Abdomen* not densely pubescent, rather shining, remotely and extremely minutely punctulate. *Legs* somewhat short and slender. Length 2.0 mm; width 0.55 mm.

Arizona (Peach Springs). Mr. Wickham.

The description is taken from the single specimen in my cabinet, which is a male. This species resembles *desertorum* in type, but has the elytra relatively much shorter and slightly dilated behind, the color paler, the pronotal punctures sparser, and the eyes appreciably larger.

9. **V. formicetorum** Wasm.—Krit. Verz. Myr. Term. Arth., 1894, p. 221 (*Anthicus*).

Narrow, feebly shining, pale brownish-testaceous throughout, the vestiture rather coarse and close, finer and short anteriorly, longer, coarser and much more conspicuous on the elytra. Head quadrate but strongly trapezoidal before the eyes as usual, convex, closely and distinctly punctate, the punctures intermingled with short feeble scratch-like rugulosities especially anteriorly; eyes moderate, nearly as long as the tempora, the latter parallel for only a very short distance, then broadly rounded to the truncate base; antennæ short, not quite as long as the head and prothorax, slender and filiform except the last five joints, which are rather abruptly enlarged, the penultimate joints not quite as long as wide. Prothorax scarcely longer than wide, fully as wide as the head, prominent and angulate at the sides anteriorly, oblique and feebly sinuate thence to the fine basal margin, circularly rounded anteriorly; surface convex, finely, densely punctate, the pubescence posteriorly inclined above but lying transversely on the flanks, more broadly behind, thus producing two feebly marked oblique lines of demarcation meeting at the middle of the base. Elytra three-fourths longer than wide, scarcely one-half wider than the prothorax, just visibly wider behind the middle than at base, broadly, obtusely rounded behind; humeri moderately exposed at base; disk scarcely at all impressed at the scutellum, not

coarsely but closely, deeply and very distinctly punctate. Abdomen minutely, very densely punctulate and pubescent, more sparsely so toward the middle and base. Legs short, the femora rather thick. Length 1.9 mm.; width 0.55 mm.

Colorado (Garland.) This very small species may be distinguished at once from the two which precede, not only by the characters given in the table, but by the more abrupt and noticeably enlarged five outer joints of the antennæ. In *formicetorum* these joints form a true, though feeble, five-jointed club, while in *desertorum* the transition from the sixth to eighth joints is so gradual in width, that there is scarcely the suspicion of a club.

10. **V. suspectus** n. sp.—Moderately stout and convex, feebly shining, pale brownish-testaceous, the suture and apex of the elytra clouded with blackish; pubescence close and conspicuous, much longer on the elytra. Head quadrate, convex, rather coarsely and somewhat closely punctate, the interspaces smooth and even; eyes small, much shorter than the tempora, the latter parallel for a long distance behind them, thence rather narrowly rounded into the broadly arcuato-truncate base; antennæ missing in the type. Prothorax large, about as long as wide and very distinctly wider than the head, the outline nearly as in the three preceding species; surface convex, finely and densely punctate. Elytra large, two-thirds longer than wide, not quite twice as wide as the prothorax, perceptibly dilated behind the middle, broadly, obtusely rounded at apex, the humeri widely exposed at base; disk strongly and conspicuously impressed at the scutellum, closely strongly and rather coarsely punctate. Abdomen somewhat closely pubescent, the punctures very minute. Legs short and rather slender. Length 2.3 mm.; width 0.7 mm.

Colorado. ?

The unique type is a female from the Levette cabinet, and is in all probability from the locality stated above. It represents a much larger and stouter species than *formicetorum*, with smaller eyes and more parallel tempora, besides the other characters heretofore mentioned.

#### HEMANTUS n. gen.

The general habitus of *Anthicus floralis* is peculiar and aberrant in its smooth subglabrous surface, in the occurrence of a subapical modification of the pronotum—always a significant structure in this family,—in its stout antennæ, robust legs with quite distinctly clavate femora, and other features, so that its systematic position among the other species has always been uncertain. When we add to these disparities of structure the

singular modification of the mesosternum, there can be but little doubt that the correct solution of its taxonomy is the erection for it of a distinct genus, and at the same time, the radical variations in this mesosternal structure show beyond peradventure that several distinct species have been confounded, not only in this country but in Europe.

The material in my cabinet can be resolved into the four following well characterized specific forms:—

Mesosternum greatly dilated at the sides, extending with rounded outline more than half way between the coxæ and the elytral humeri, its outer margin bearing a close fringe of long fine decumbent hairs; pronotum constantly with a small feeble double tubercle in the middle near the apex.

(Subgenus I).....1. **floralis**

Mesosternum very much less developed laterally, intervening obliquely between the coxæ and episternum but only slightly more so than in *Anthicus*, its outer margin not fimbriate; pronotum constantly devoid of any trace of the subapical tubercle. (Subgenus II)

Prothorax more finely and sparsely punctate, feebly and more obtusely constricted near the base.

Prothorax very narrowly and strongly rounded at the sides near the apex.

2. **enodis**

Prothorax broadly rounded at the sides anteriorly, much more feebly oblique and gradually narrowed thence to the subbasal constriction.

3. **scenicus**

Prothorax more strongly and closely punctate, the posterior constriction deep and almost rectangular, the basal margin much wider and more strongly expanded.....4. **rixator**

The American *floralis* extends without noticeable variation over the entire country, but my material in the second subgenus is not sufficiently extensive to enable me to pronounce any useful opinion as to geographical distribution. This is however an interesting subject, and well merits careful attention from those possessing large series.

1. **H. floralis** Linn.—Faun. Suec., No. 830, 1735 (Meloe); LaFerté: Mon., p. 150; Lec.: Proc. Acad., Phila., 1852, p. 98 (*Anthicus*); *basillaris* Say: Journ. Acad. Nat. Sci., Phila., 3, p. 279 (*Anthicus*).

Stout, polished, subglabrous, the pubescence of the elytra noticeable but extremely short and sparse; head piceous, the prothorax pale rufo-testaceous; basal third or fourth of the elytra pale brownish-flavate, the remainder piceous-black. Length 2.7–3.1 mm.; width 0.9–1.1 mm.

Indiana, Iowa (Keokuk), Texas (Galveston and El Paso) and California (Lake Co). This common and apparently cosmopolitan species has been thoroughly described by LaFerté, and may always be recognized by the small double tubercle of the pronotum, which is not wanting in any specimen of the true *floralis* which I have seen; in some specimens the feeble depression between the tubercles is prolonged along the median line for a considerable distance toward base. In the male the general form is stouter, the head and prothorax especially being broader, and the antennæ apparently a little longer and thicker, but the mesosternum and pronotal tubercle are not at all affected sexually. The most remarkable external sexual difference relates to the form of the pygidium, which, in the male, is vertical and strongly convex, while in the female it is nearly flat, extremely oblique and almost horizontal. It is not only probable that this is not the *Meloe floralis* of Linné, but quite possible that it may be different from the *Anthicus floralis* of European authors, though belonging to the same subgenus, for the length of the European insect as given by LaFerté\* (3.0–3.5 mm.), is substantially greater than that of the American representative, and LaFerté seems to be very accurate and careful in his measurements.

2. **H. enodis** n. sp.—Stout, convex, anterior parts shining, the elytra polished, dark rufo-testaceous, the metasternum, abdomen and head blackish; pronotum blackish anteriorly; elytra piceous-black, gradually and indefinitely paler toward base; antennæ and legs dark brownish-rufous; femora darker; pubescence decumbent, extremely short and sparse, the elytra also with exceedingly short remote and erect setæ. *Head* moderate in size, thick, convex, truncate and strongly, medially impressed at base, subquadrate, as long as wide; eyes moderately large and convex, about as long as and more prominent than the tempora, the latter parallel; basal angles broadly rounded; disk finely but strongly, not densely punctate, the punctures intermingled with short vermiculate scratches, which become gradually dense and close toward the sides; antennæ not as long as the head and prothorax, very thick and submoniliform, gradually and rather feebly incrassate, the penultimate joints nearly as long as wide. *Prothorax* as wide as the head, fully as long as wide, narrowly rounded and widest between apical fourth and fifth, the sides thence rather strongly oblique and nearly straight to the subbasal constriction; apex transversely arcuate; disk with an impressed fold parallel to the basal margin, which is continued obliquely upon the flanks in a deep impression,

\*Accurate and minute measures of length and width are one of the most important aids in identifications from description, and more care should be devoted to them than is usually the case.

which produces the constriction as seen from above; collar short, broad, constricted at base; punctures fine but strong, rather sparse, slightly larger toward base. *Elytra* scarcely two-thirds longer than wide, not quite twice as wide as the prothorax, widest and somewhat prominently rounded just behind the middle, broadly and obtusely rounded at apex; humeri rounded, broadly exposed at base; scutellar impression obsolete, each elytron transversely impressed at basal fifth and thence longitudinally within the humeri, the omoplates large and distinct; punctures moderately small, strong and well separated, finer toward apex. *Abdomen* alutaceous, very minutely, rather closely punctate, finely and distinctly pubescent. *Legs* moderate in length, somewhat stout, the femora thick and clavate, the anterior more strongly so. Length 2.7–2.9 mm.; width 0.9 mm.

California (San Francisco).

The description is drawn from the male, the female, however, not differing perceptibly in form. In the male the pygidium is convex and subvertical, the fifth ventral very feebly and just visibly sinuate at the middle of the apex, the genital segment well-developed, broadly, rather strongly sinuate throughout its apical width in circular arc, the vertical edge of the sinuation thickened and transversely foveate in the middle; the copulatory spicule is slender, feebly impressed along its under surface, gradually and very feebly dilated and thickened toward apex, the latter obtuse and circularly arcuate. A single pair.

3. **H. scenicus** n. sp.—Moderately stout and convex, thick, shining, pale rufo-testaceous, the head only slightly darker; elytra piceous-black, paler and more flavate in basal fourth; abdomen blackish; pubescence very short and sparse. *Head* subquadrate, as long as wide, evenly convex, finely, rather sparsely punctate, with other sculpture as in *enodis*, the fine smooth line entire; base subtruncate, broadly and somewhat feebly impressed in the middle; angles very broadly rounded, becoming parallel just behind the eyes, which are rather large though only moderately convex, much longer than the tempora; antennæ about as long as the head and prothorax, only moderately thick, very feebly incrassate, the tenth joint subquadrate. *Prothorax* distinctly narrower than the head, a little longer than wide, widest and rather broadly rounded at apical fourth, the sides oblique and feebly arcuate thence to the subbasal constriction; basal margin wide and strong, dilated at the sides as usual; punctures fine and rather dense. *Elytra* long, fully three-fourths longer than wide, not quite twice as wide as the prothorax, a little wider behind the middle than at base; humeri broadly exposed and rounded to the prothorax; impressions and sculpture nearly as in *enodis*: *Abdomen* dull, distinctly pubescent, the legs thick. Length 2.8 mm.; width 0.9 mm.

Rhode Island.

A single male, differing greatly from *enodis* in its more elongate



elytra, longer and thinner antennæ, larger eyes, shorter tempora and in the form of the prothorax. The modification of the genital segment is nearly as in *enodis*, but the thickened edge of the sinuation toward the middle is wider and simply vertical, not foveate.

4. **H. rixator** n. sp.—Rather stout, thick and convex; legs, pro- and mesosterna, median parts of the head beneath, antennæ and pronotum toward base, rufo-testaceous in various shades; head, pronotum toward apex, metasternum and abdomen darker, piceous-black; elytra dark piceous or brownish testaceous, gradually slightly paler and more flavous toward base; pubescence very short and sparse but distinct. *Head* convex, subquadrate, as long as wide; truncate and moderately impressed in the middle at base; eyes rather small but convex, much shorter and more prominent than the tempora, the latter parallel behind them for some distance, then rounded into the base; disk dull, densely and strongly strigoso-reticulate, the fine impunctate line shining anteriorly, the punctures fine but strong, somewhat dense; antennæ not quite as long as the head and prothorax, thick, moderately incrassate, the tenth joint distinctly transverse. *Prothorax* fully as wide as the head, not longer than wide, strongly rounded and widest at apical fourth, the sides thence strongly oblique and very slightly arcuate to the deep and conspicuous ante-basal constriction; basal margin wide, strongly dilated at the sides; disk alutaceous, reticulate, finely, deeply and closely punctate. *Elytra* scarcely three-fourths longer than wide, distinctly less than twice as wide as the prothorax, the sides parallel and almost evenly, feebly arcuate, broadly obtuse at apex; humeri broadly and transversely exposed at base; sculpture and impressions nearly as in the preceding species, the surface shining. *Legs* moderate, the femora not very stout except the anterior. Length 2.9 mm.; width 0.95 mm.

Texas (Galveston); New Mexico (Albuquerque).

The three specimens before me are females, and the species may be readily known from the others here described by the dull and rather densely punctate head, deep constriction of the prothorax and other characters; the mesosternum, also, is apparently a trifle more dilated at the sides. The base of the prothorax is much broader and more dilated than in *enodis*.

#### **ANTHICUS** Payk.

Even in its restricted scope, this genus is still a large one and to some extent heterogeneous, including as it does species of widely different facies, such as *horridus*, *haldemani* and *maritimus*. They all agree, however, in sternal, abdominal and crural structure and cannot very well be subdivided in a generic sense, although *maritimus* is certainly very aberrant in its oval, subconnate elytra, with probable absence of hind wings.

The genus *Anthicus*, as here limited, may be said to comprise those species of the tribe Anthicini which have the mesosternum normal and undilated, the last joint of the antennæ entire, the pronotum unmodified in structure, and the vestiture simple,—that is, consisting of a single set of hairs, disregarding in this connection the erect setæ which are especially tactile in function. The last joint of the maxillary palpi is moderate in size and securiform, and the antennæ are comparatively short and gradually enlarged toward apex,—never capitate as in *Sapintus*. It is very abundant in species throughout the United States, but, in common with all other heteromeride groups, is particularly well represented in the southwestern parts of the country and in the regions bordering the Pacific Ocean.

The species known to me may be identified by the following provisional table:—

|   |                     |
|---|---------------------|
| Elytra with distinct humeri.....  | 2                   |
| Elytra oval and convex, without humeri.....   | 27                  |
| 2—Body hispid throughout with very long erect setæ.....   | 3                   |
| Body with shorter pubescence.....   | 4                   |
| 3—Head strongly rounded behind in circular arc.....   | 1. <b>horridus</b>  |
| Head truncate at base.....  | 2. <b>rufulus</b>   |
| 4—Head strongly and semi-circularly rounded behind the eyes.  |                     |
| Pale testaceous, the elytra biguttulate.....  | 3. <b>cribratus</b> |
| Black, the elytra quadriguttulate.....  | 4. <b>hecate</b>    |
| Head truncate or broadly arcuate at base, the temporal angles more or less distinct; pronotum normally convex throughout, not modified near the apex.....   | 5                   |
| 5—Larger or medium species, seldom under $2\frac{1}{2}$ mm. in length, the sides of the prothorax generally oblique and arcuate toward base or the subbasal constriction, and broadly rounded anteriorly.....           | 6                   |
| Small species never exceeding $2\frac{1}{2}$ mm. in length, the sides of the prothorax generally more or less prominently rounded anteriorly, and oblique and nearly straight or feebly sinuate thence to the base..... | 19                  |
| 6—Abdomen rather coarsely and more sparsely punctate; body pale in color...   | 7                   |
| Abdomen always minutely and more or less densely punctate.....  | 10                  |
| 7—Pronotum simply punctate; apex of the copulatory sheath rapidly narrowed, the extreme tip minutely prominent.....   | 8                   |
| Pronotum sculptured in longitudinal rugæ, the copulatory sheath gradually and arcuately narrowed to an ogival point, at least in <i>compositus</i> .....  | 9                   |
| 8—Temporal angles broadly rounded.  |                     |
| Pubescence relatively long, coarse and conspicuous; elytral fascia generally distinctly black.  |                     |
| Eyes large, much longer than the tempora.....   | 5. <b>ephippium</b> |
| Eyes smaller, subequal in length to the tempora.....  | 6. <b>simiolus</b>  |

- Pubescence shorter, not so erect and less conspicuous; body smaller and narrower, pale flavo-testaceous throughout, the elytra rarely feebly suffused toward the middle with brownish.....7. **luteolus**
- Temporal angles distinct and rather narrowly rounded; form more obese; punctures denser and not so coarse; dark markings of the elytra suffused, never black.....8. **pinguescens**
- 9—Head simply punctate; pronotal rugæ long, fine and anastomosing.
9. **flavicans**
- Head covered with small strongly elevated tubercles; pronotal rugæ coarse and much broken up, forming irregular tubercles.
- Tubercles of the head smaller and denser; antennæ shorter and more incrassate.....10. **scabriceps**
- Tubercles large and sparse; antennæ slender; pubescence longer, coarse and somewhat unequal.....11. **compositus**
- 10—Unicolorous, either black or paler, when pale having the elytra frequently indefinitely fasciate near the middle and apex, enclosing an ocellate pale spot behind the middle.....11
- Black, each elytron with a well defined pale spot near the base and another near the apex, occasionally mutually confluent either transversely or longitudinally according to the species; prothorax feebly constricted at some distance before the base; head impressed in the middle at base; trochanters not spinose in the male.....18
- 11—Head and pronotum extremely finely and densely punctate, dull; elytra as in *biguttulus*, entirely black.....12. **nigrita**
- Head and pronotum distinctly and less densely punctate.
- Posterior trochanters of the male prolonged posteriorly in a very slender spine; prothorax generally broadly rounded at the sides.....12
- Posterior trochanters not spinose in the male.....13
- 12—Elytra pubescent.
- Prothorax oval, widest at the middle.....13. **ovicollis**
- Prothorax widest distinctly before the middle.
- Elytra less elongate, leaving the extreme tip of the abdomen exposed.
- Black or paler, with a rather ill-defined spot of paler tint behind the middle, which is frequently obsolete in the black forms.
14. **biguttulus**
- Black, the elytral apex margined with testaceous; pronotal punctures much coarser and sparser.....15. **hastatus**
- Elytra longer, completely covering the abdomen.
- Sides of the elytra in apical two-fifths convergent and straight to the broadly rounded apex; punctures of the head fine and dense.
16. **protectus**
- Sides of the elytra evenly rounded behind; head coarsely and sparsely punctate.....17. **solidus**
- Elytra glabrous.....18. **subcalvus**
- 13—Head and pronotum glabrous and alutaceous; basal margin of the prothorax completely obsolete.....19. **coracinus**

Head and pronotum pubescent as usual.

Prothorax constricted at the sides at some distance before the base.....14

Prothorax oblique and straight at the sides from apical third or fourth to the basal margin.....17

**14**—Body black throughout .....15

Body piceous or paler.....16

**15**—Head strongly and closely punctate.

Elytra shorter, never more than three-fourths longer than wide, with the pubescence longer and conspicuous.

Head slightly wider than the prothorax; larger convex species.

**20. monticola**

Head very much wider than the prothorax; elytra flatter.

**21. cephalotes**

Elytra longer, nearly twice as long as wide; elytral pubescence very short.

**22. punctulatus**

Head finely and sparsely punctate.....**23. decrepitus**

**16**—Antennæ longer, fully as long as the head and prothorax.

Elytral punctures very dense and not coarse.

Eyes small; head moderately convex, strongly impressed at base.

**24. mercurialis**

Eyes rather large; head strongly convex, not or obsoletely impressed at base.

Antennæ slender, feebly incrassate.....**25. cervinus**

Antennæ stouter and rather strongly incrassate.....**26. gilensis**

Elytral punctures coarse and sparse.....**27. præceps**

Antennæ short and slender, one-half longer than the head.

**28. seminotatus**

**17**—Prothorax rounded at the sides anteriorly.

Antennæ longer, very slender but distinctly enlarged near the apex.

**29. parallelus**

Antennæ shorter and stouter, less incrassate; much smaller species

**30. ancilla**

Prothorax obtusely prominent at the sides anteriorly; elytra large, flat; body black.....**31. sodalis**

**18**—Elytral punctures rather coarse and less dense, the surface shining.

Larger species, the elytral pubescence long and distinct.....**32. heroicus**

Smaller, the pubescence very short.....**33. haldemani**

Elytral punctures finer, generally very dense, with the surface dull; pubescence short throughout.

Basal spots rounded and smaller; lustre less dull.

Basal spots extending to the basal margin; form stout.....**34. stellatus**

Basal spots small and at some distance behind the basal margin.

**35. auriger**

Basal spots longitudinally elongate.

These spots isolated, never confluent.

Elytra broader, suboval and convex.....**36. saucius**

Elytra flatter and more parallel.....**37. vulneratus**

- These spots confluent transversely, the entire basal third of the elytra being abruptly pale.....38. **junctus**
- These spots confluent longitudinally on each elytron, the posterior spot also elongated; head large, the prothorax small.....39. **decorellus**
- 19**—Head coarsely, sparsely and frequently subrugosely punctured, with a wide and entire median impunctate line.....20
- Head finely and more or less densely punctate.....23
- 20**—Color uniformly pale flavo-ferruginous, the elytra rarely somewhat clouded toward the middle.....21
- Color piceous or blackish, the cephalic punctures generally less sparse...22
- 21**—Eyes smaller, not quite as long as the tempora.
- Very small species, the eyes much shorter than the tempora; head only just visibly wider than the prothorax.....40. **nanus**
- Larger, the eyes almost as long as the tempora; head much larger than the prothorax.....41. **vagus**
- Eyes larger, always distinctly longer than the tempora.
- Head subequal in width to the prothorax.
- Smaller, the elytra shorter, with the humeri rather narrowly exposed and rounded at base.
- Pronotum more coarsely and rather sparsely punctured; elytral pubescence decumbent and similar to that of the pronotum.
42. **peninsularis**
- Pronotum finely, sparsely punctured; elytral pubescence longer and more erect than that of the pronotum.....43. **nympha**
- Larger, the elytra longer and wider, with the humeri much more broadly and transversely exposed at base; pronotum finely and densely punctured.....44. **obliquus**
- Head much wider than the prothorax.....45. **innocens**
- 22**—Tempora somewhat swollen, as prominent as the eyes.....46. **inscitus**
- Tempora longer, straight and parallel, less prominent than the eyes; elytra in the paler examples broadly fasciate in the middle with a slightly darker tint.....47. **amoenus**
- 23**—Prothorax broadly rounded anteriorly, the sides convergent and arcuate to a feeble ante-basal constriction; head equal in width to the prothorax.
48. **obscorellus**
- Prothorax narrowly but distinctly rounded at the sides anteriorly; head wider than the prothorax.....24
- Prothorax subangulate and prominent at the sides anteriorly; tempora rather swollen and subprominent.....26
- 24**—Prothorax longer than wide; body black, the elytral humeri abruptly rufo-testaceous .....49. **militaris**
- Prothorax short and small, never longer than wide.
- Elytra pale, with a clearly defined median black fascia.....50. **bellulus**
- Elytra unicolorous or more or less indefinitely nubilate.
- Pubescence very short throughout; head and pronotum extremely densely punctate and dull.....51. **helvinus**

- Pubescence longer and distinct; anterior parts less densely punctate and shining.
- Eyes moderately large, about as long as as the tempora, convex and prominent; pubescence only moderately long....52. **lutulentus**
- Eyes smaller, very much shorter than the tempora.....25
- 25**—Prothorax larger, subequal in width to the head; body black throughout, the pubescence long, coarse, cinereous and conspicuous...53. **agilis**
- Prothorax small, distinctly narrower than the head.
- Eyes moderately small and prominent, not less than three-fourths as long as the tempora.
- Pubescence long, coarse, cinereous and very conspicuous; punctures of the head strong and dense.....54. **herifuga**
- Pubescence shorter, finer and less conspicuous, especially on the head; punctures of the latter more minute and much less dense; elytral base and apex pale.....55. **mundus**
- Eyes very small, convex and prominent, about one-half as long as the tempora; body much smaller and more convex.....56. **melancholicus**
- 26**—Eyes very small and prominent, much shorter than the tempora; body narrow and minute.....57. **ictericus**
- Eyes larger and less convex, subequal to the tempora; body larger and much stouter.....58. **convexus**
- 27**—Head subquadrate, parallel at the sides; prothorax somewhat longer than wide, broadly rounded at the sides anteriorly, the disk not modified at apex.....59. **maritimus**

In this genus, as in all other large genera containing numerous species which are abundant as a rule in individuals and widely diffused, there are certain pronouncedly distinct typical forms surrounded by others, evidently closely related, and derived from a common progenitor in comparatively recent times. It is not, however, for the systematist at the present time to pronounce any definite opinion concerning the status of these more closely allied species; he can only record them in order that they may be referred to by future investigators, provided with more ample data. Only those forms are here described under separate names which differ structurally to a definite and obvious degree, and their true relationships will be a problem to be solved mainly by a study of life habits and interbreeding, if such subtle matters can ever be looked into.

[1. **A. horridus** Lec.—Ann. Lyc. Nat. Hist., N. Y., V, p. 154; Proc. Ac. Nat. Sci., Phila., 1852, p. 98.

One of the most remarkable species of the genus, rather stout, flavate, with extremely coarse and sparse elytral punctures, the

entire body and legs bristling with very long erect hairs, which are from one-third to one-half as long as the entire width of the prothorax; also clothed with shorter sparse and more decumbent hairs. Head rather longer than wide, coarsely and sparsely punctate, with a wide impunctate median line not extending to the base, the latter arcuate; eyes large and prominent; antennæ a little longer than the head and prothorax, gradually enlarged at apex. Prothorax very coarsely punctured, a little longer than wide, subequal in width to the head. Elytra large, about two-thirds longer than wide and twice as wide as the prothorax, convex, the omoplates not distinct. Length 3.0 mm.; width 1.0 mm.

Arizona (Gila River),—Cab. LeConte. I have before me a specimen from Tucson, which agrees well with the above short notes which I drew up some years ago from the original type.

2. **A. rufulus** Lec.—Ann. Lyc., V, p. 155; Proc. Acad., 1852, p. 100.

This is also a very distinct species, represented at present by the unique type in the LeConte cabinet at Cambridge, Mass. It also has the body clothed sparsely with long erect hairs, which are one-third as long as the width of the prothorax, but the head is truncate, quadrate, closely and not very coarsely punctate, with a narrow impunctate line; eyes large; antennæ thick, a little longer than the head and prothorax. Prothorax convex, the sides oblique, not sinuate, a little narrower than the head and as long as wide, the punctures fine but deep, even, rather close but distinctly separated. Elytra twice as long as wide, not quite twice as wide as the prothorax, the punctures strong but not remarkably coarse, separated by nearly twice their own diameters. Length 2.5 mm.; width 0.8 mm.

California (San Diego). I have not had an opportunity to examine this species for generic characters of the mesosternum, but infer that it is properly placed here, in spite of its resemblance in form to *vicinus*, as related by LeConte.

3. **A. cribratus** Lec.—Proc. Acad. Nat. Sci., Phila., 1852, p. 98.

Polished, pale testaceous, the elytra each with a large subcircular spot at apical fourth of paler flavate, which is usually rendered still more obvious by blackish anterior and posterior margins; pubescence rather long, coarse, sparse, equal and posteriorly recurved, cinereous in color. Head coarsely punctate, with a

narrow impunctate median line; eyes rather large, prominent, somewhat before the middle; antennæ slender, incrassate, barely as long as the head and prothorax, the joints strongly obconical, the tenth subquadrate. Prothorax small and narrow, distinctly narrower than the head and longer than wide, coarsely, moderately closely punctate. Elytra four-fifths longer than wide, two and one-half times wider than the prothorax, gradually narrowed behind the middle and not very broadly rounded at apex; disk very coarsely, deeply punctate, the punctures separated by rather more than their own diameters, much finer toward apex. Length 3.0–3.3 mm.; width 0.85–1.0 mm.

California, from Sonoma to the southern parts of the State. The male sexual characters are feeble, the fifth segment being entirely unmodified on the disk and rounded at apex, the genital segment feebly sinuato-truncate throughout its width. The corneous sheath of the copulatory apparatus is quite simple, reduced to a flattened fillet, feebly excavated along its under surface, gradually and evenly narrowed from base to apex, the latter obtusely rounded and blunt, not at all enlarged or modified; viewed in profile, however, this corneous organ is seen to depart somewhat from the usual form in curvature, for, instead of being bent downward, it is feebly bent upward toward apex, the entire organ being protruded vertically downward in normal fashion from the abdominal apex; it is only about one-fourth as long as the abdomen.

4. **A. hecate** n. sp.—Moderately stout and convex, polished, black throughout, the legs and antennæ pale flavo-testaceous; elytra each with a large ill-defined spot near the base and another, rounded, at apical fourth, of testaceous, the suture also sometimes feebly suffused with a reddish tinge; pubescence long, coarse, cinereous, rather sparse but conspicuous. Head as long as wide, convex, strongly, somewhat closely punctate, with a broad smooth median line which almost attains the base; eyes large, prominent, rather before the middle; antennæ not quite as long as the head and prothorax, feebly incrassate, the second joint short, third elongate and distinctly longer than the fourth, tenth as long as wide. Prothorax small, much narrower than the head, exclusive of the collar not longer than wide, convex, rather coarsely and closely punctate, broadly rounded at the sides anteriorly, feebly narrowed thence to a short distance before the base where the sides become parallel; collar long and strongly developed, finely, densely punctate, finely constricted at base; basal margin subobsolete toward the middle. Elytra nearly twice as long as wide, about two and one-third times as wide as the prothorax, scarcely visibly wider behind the middle than at base, thence gradually narrowed to



the apex which is not broadly rounded; base broadly truncate; punctures coarse and rather sparse; post-scutellar impression broad and distinct, the omoplates very feeble. *Abdomen* polished, finely, somewhat closely punctate, the pubescence short and abundant. *Legs* long, very slender. Length 3.0 mm.; width 1.0 mm.

California (San Mateo, near San Francisco).

This species is closely allied to *cribratus*, differing in its less sparse, shorter, less erect and bristling pubescence, more narrowly rounded and prominent humeri which are more transverse at base, and in coloration. The latter is evidently a development of the pattern seen in *cribratus*, but is very constant in the four specimens before me, and is equally constant in my four specimens of *cribratus*.

5. **A. ephippium** Laf.—Mon., p. 163; *difficilis* Lec.: Agass. "Lake Superior," p. 230; Proc. Acad. Nat. Sci., Phila., 1852, p. 99; *confusus* Lec.: l. c., p. 99.

The general description of LaFerté, more especially the phrase "tête distinctement ponctuée," and the dimensions—3.0 by 1.0 mm.—leave scarcely a doubt that the true *ephippium* of that author is the species named *difficilis* by LeConte; and the form described subsequently under the name *confusus* is identical in every way, the two large series in the LeConte cabinet agreeing completely, even to the specimens which bear the type-labels.

This species occurs throughout North America east of the Rocky Mountains, from New York to Texas (El Paso). Some specimens from Wyoming are feebly marked like the Californian *pinguescens*, but they may be readily distinguished from that species by the sparser punctuation and rounded temporal angles.

The corneous copulatory sheath is elongate, parallel-sided, transversely and strongly convex toward base, flattened toward apex, where it is rather abruptly narrowed in the form of a perfect ogive, the apex of the ogive produced slightly in a small prominent point; the lateral edges of the flattened portion toward apex are broadly reflexed. In profile the organ is straight; the membranous efferent duct beneath is large and subcylindrical.

6. **A. simiolus** n. sp.—Polished, dark rufo-testaceous, the under surface of the hind body, and a large median cloud on each elytron which is a little more longitudinally developed at the sides, black; antennæ and legs ochreous-yellow; pubescence rather long, coarse, semi-erect, sparse but cinereous and conspicuous. *Head* subquadrate, a little wider than long, broadly

rounded and minutely impressed in the middle at base, feebly convex, strongly but sparsely punctate, with a wide impunctate line; eyes moderately large and prominent, subequal in length to the tempora; basal angles moderately distinct; antennæ slender, feebly incrassate, as long as the head and prothorax, the tenth joint as long as wide. *Prothorax* slightly narrower than the head and a little wider than long, the sides strongly rounded anteriorly, thence oblique and feebly arcuate to basal fourth, then subparallel to the base; disk strongly and rather closely punctate; collar wide and well developed. *Elytra* two-thirds longer than wide, twice as wide as the prothorax, distinctly wider at the middle than at base, the apex not broadly, evenly rounded; humeri widely rounded; omoplates very feeble; punctures coarse and sparse. *Legs* moderate in length, not very slender. Length 2.8–3.3 mm.; width 0.85–1.15 mm.

Vancouver Island (Victoria). Mr. Wickham.

Closely allied in general characters and coloration to *ephippium*, but distinguishable very readily by the much smaller eyes. The copulatory sheath is similar in form to that of *ephippium* but is more gradually and acutely ogival, the apex of the ogive produced in a finer point; on the upper surface at apex the sides are very much more narrowly and feebly reflexed than in *ephippium*.

**7. A. luteolus** Lec.—Ann. Lyc. Nat. Hist., N. Y., V, p. 154; Proc. Acad., Phila., 1852, p. 99.

Rather narrow, moderately convex, polished, pale ochreous-flavate throughout, the elytra sometimes very feebly clouded toward the middle but never distinctly fasciate; pubescence coarse, sparse, pale in color, subdecumbent and only moderately long. Head quadrate, broadly rounded at base, coarsely, rather sparsely punctate, with an impunctate line; basal angles rounded; eyes large. *Prothorax* slightly narrower than the head, fully as wide as long, similar in form to that of *ephippium* but more coarsely and sparsely punctate. *Elytra* about four-fifths longer than wide, scarcely twice as wide as the prothorax, gradually narrowed behind the middle, the apex somewhat narrowly rounded; punctures coarse, rather sparse, only slightly smaller toward apex. Abdomen finely and very sparsely punctate. Length 2.7 mm.; width 0.8 mm.

California (Yuma) and Arizona (East Bridge). This form is smaller, narrower and paler than any of the others of the *ephippium* group, and the elytral punctures are more uniform in size throughout the disk; the pubescence, also, is decidedly shorter

and more decumbent. The description of LeConte is misleading in regard especially to the form of the prothorax, which does not differ from his *difficilis* to any noticeable degree.

8. **A. pinguescens** n. sp.—Rather stout, convex, shining, dark piceous, the under side black; elytra pale brownish-flavate, very feebly and indefinitely clouded with piceous in an oblique spot at the middle of each; legs and antennæ pale; pubescence coarse, semi-erect, cinereous, not dense but conspicuous. *Head* quadrate, as long as wide, feebly convex, coarsely, deeply, moderately closely punctate, with an almost entire median impunctate line; eyes large, prominent, the tempora straight and parallel, with the flanks flattened behind the eyes, about two-thirds as long as the latter; base broadly arcuate, not at all impressed, the basal angles very distinct and rather narrowly rounded; antennæ somewhat slender, feebly incrassate, not quite as long as the head and prothorax, the tenth joint fully as long as wide. *Prothorax* large, convex, fully as wide as the head, a little wider than long, narrowly rounded at the sides anteriorly, the sides oblique and feebly arcuate thence to basal fourth or fifth, then parallel to the base; collar broad, strongly developed; punctures deep, rather coarse and close; basal margin narrow but distinct. *Elytra* three-fourths longer than wide, twice as wide as the prothorax, the sides parallel and feebly arcuate, a little more convergent behind the middle, the apex somewhat broadly rounded; humeri widely and transversely exposed at base; omoplates very feeble; punctures rather coarse, separated by scarcely more than their own widths. *Abdomen* polished, finely but not densely punctate, the legs long and rather stout. Length 3.2 mm.; width 1.15 mm.

California (San Francisco to Los Angeles).

The male has the posterior tibiæ broadly, feebly swollen within in basal two-thirds, the fifth ventral unmodified, rounded behind, the genital segment arcuate at tip in the middle and thence sinuate for a short distance to each lateral angle. The copulatory sheath is parallel-sided, as in the preceding species, but the tip is much more abruptly and briefly ogival, the apex of the ogive produced in a broader, obtusely rounded process, the flattened superior surface at apex only very slightly and narrowly impressed along the obliquely rounding sides of the ogive. Six specimens.

The four preceding species are mutually closely allied, and evidently descended from a common stock in comparatively recent times. Whether they should be termed species or geographical varieties is, at the present time, a matter of opinion; they all differ by well marked peculiarities of structural detail, and, in the opinion of the writer, can be considered geographical varieties only in the sense that all the species of a genus are geographical

or environmental varieties of a common parent species. These four species, and probably a few others yet to be described, constitute a subgenus or a small and pure genus within a large and complex so-called genus, as shown by the common type of sexual organization. Primary sexual characters are, as far as known, exceedingly constant and permanent features, and decided differences in them should apparently indicate divergence at comparatively remote epochs. In fact, as before indicated, these sexual characters when differing decidedly in type are extremely important taxonomic elements, and are often indices of generic identity. This is not to say that all such genera should necessarily receive distinct appellations at present, nor does it mean that these are the only criteria for the estimation of genera, as we frequently meet with entire families, which must be split up into genera because of certain more or less apparently important morphological inconsistencies, in which the sexual structure is quite uniform; but it means that those groups in which the sexual structure is varied are, as a rule, the oldest and most permanently established aggregates, in spite of any accidental similarities in outward form or habitus.

9. **A. flavicans** Lec.—Proc. Acad. Nat. Sci., Phila., 1852, p. 99.

Moderately stout, convex, the elytra polished, dark rufo-testaceous, the abdomen blackish; elytra blackish at apex and at the middle; pubescence long, coarse, shaggy and conspicuous. Head quadrate, feebly convex, truncate at base, with a very obsolete median impression; basal angles right and distinct; eyes moderate, prominent, not longer than the tempora which are parallel to the base; surface strongly, closely punctate, with an entire median impunctate line; antennæ slender, feebly incrassate. Prothorax scarcely narrower than the head, convex, fully as wide as long, the sides rounded anteriorly, thence moderately convergent and feebly arcuate to basal fifth, then parallel to the base, the latter feebly margined; disk with long fine and close, longitudinal and anastomosing rugæ, which are punctured at the bottom. Elytra three-fourths longer than wide, barely twice as wide as the prothorax, convex, rather narrowly rounded behind, somewhat coarsely and sparsely punctate; omoplates invisible. Abdomen rather sparsely punctate. Length 2.3–3.1 mm.; width 0.8–1.1 mm.

Montana, Wyoming and Iowa; obtained in large numbers at

various localities by Mr. Wickham. It varies considerably in color and size, some specimens having entirely flavate elytra; the head and prothorax are always a little darker, however.

10. **A. scabriceps** Lec.—Agassiz "Lake Superior," p. 230; Proc. Acad. Nat. Sci., Phila., 1852, p. 99.

Rather narrow, convex, variable in color; surface shining; pubescence coarse and sparse, cinereous and distinct. Head subquadrate, wider than long, feebly convex, truncate and broadly, feebly impressed at base; basal angles distinct; eyes moderate, about as long as the tempora, the latter parallel; surface somewhat closely covered with small, strongly elevated tubercles, the integument polished; median smooth line partially obliterated; antennæ moderately stout and incrassate. Prothorax somewhat narrower than the head and fully as wide as long, convex, the sides broadly rounded, convergent behind the middle to near the base; surface with confused tuberculate sculpture, the punctures bearing the hairs minute. Elytra four-fifths longer than wide, twice as wide as the prothorax, the sides parallel and feebly arcuate; surface coarsely and sparsely punctate, the omoplates obsolete. Abdomen polished, finely and remotely punctate. Legs slender. Length 2.5 mm.; width 0.8 mm.

Lake Superior,—Cab. LeConte. The general color is black throughout, with the elytra a little paler at apex, but paler specimens occur with the elytra testaceous throughout, or having a median black fascia.

11. **A. compositus** n. sp.—*A. ephippium* Lec. nec Laf.: Proc. Acad. Nat. Sci., Phila., 1852, p. 99.—Moderately stout, convex, polished, pale rufo-testaceous, the under surface of the body and a median elytral fascia black, the latter generally feeble and frequently obsolete; pubescence cinereous, coarse, rather short and subdecumbent anteriorly, very long erect and bristling on the elytra, the hairs varying in length. Head subquadrate, as long as wide, moderately convex, polished, truncate and feebly impressed at base, the angles somewhat distinct; eyes large, longer than the tempora; surface sparsely tuberculose and with intermingled sparse punctures, also with an entire median smooth line; antennæ slender, barely as long as the head and prothorax, very feebly incrassate. Prothorax distinctly narrower than the head, about as long as wide, rounded at apical third, the sides thence oblique and arcuate to basal fifth, thence slightly expanded to the basal margin which is feebly defined; collar large, very feebly constricted; surface convex, coarsely and confusedly tuberculose and finely, sparsely punctulate. Elytra three-fourths longer than wide, fully twice as wide as the prothorax, parallel and evenly arcuate at the

sides from base to apex, the apex moderately broadly rounded; humeri widely exposed; omoplates subobsolete; punctures very coarse and sparse. *Abdomen* polished, sparsely punctate, the legs slender. Length 2.2–2.4 mm.; width 0.75–0.8 mm.

New York (Willels Point, Long Island).

A much smaller species than *ephippium* Laf., and distinguishable from *scabriceps*, to which it is closely allied, by its shorter, more oval elytra, longer and more erect elytral vestiture, sparser cephalic sculpture and several other characters. It seems to be rare and rather local. Five specimens.

The copulatory sheath is as simple as possible, consisting of a straight paralld-sided fillet, transversely convex above throughout and not at all impressed at the sides toward apex, the latter arcuately narrowed in a perfect ogive, with well defined angulate but unmodified tip; the under surface of the organ is deeply excavated throughout its entire length for the efferent duct.

12. **A. nigrita** Mann.—Bull. Soc. Imp. Nat. Mosc., 1853, p. 269.

Body black throughout. Head and prothorax finely, extremely densely punctate and opaque, the punctures subconfluent; eyes rather small, at a little more than their own length from the base; antennæ somewhat thick, a little longer than the head and prothorax, the intermediate joints but slightly longer than wide, the tenth a little wider than long. Prothorax very slightly narrower than the head, not quite as long as wide, evenly convex. Elytra throughout as in *biguttulus*, but entirely black. Length 3.2 mm.; width 1.25 mm.

Alaska (Kenai). The above outline notes were taken from the single specimen in the LeConte cabinet.

13. **A. ovicollis** n. sp.—Stout, convex, somewhat shining, brownish-testaceous throughout above and beneath, the head piceous-black; pubescence abundant, moderate and uniform in length, semi-erect, dusky-cinereous in color. *Head* subquadrate, as wide as long, transverse, feebly arcuate and unimpressed at base, the angles broadly rounded, the tempora large, becoming gradually parallel near the eyes, the latter moderately large and prominent; surface finely, rather closely punctate, the impunctate line only visible toward base; antennæ about as long as the head and prothorax, somewhat stout, distinctly incrassate, the tenth joint distinctly longer than wide. *Prothorax* rather distinctly narrower than the head, a little longer than wide, strongly, evenly convex, broadly rounded at the sides, the latter gradually convergent and arcuate anteriorly to the somewhat narrow collar, feebly convergent in basal third to the moderately wide and distinct basal margin, which is feebly

expanded laterally; punctures rather coarse, deep and very close though distinctly separated. *Elytra* large, two-thirds longer than wide, a little more than twice as wide as the prothorax, quite distinctly wider just behind the middle than at base, the apex somewhat broadly rounded; omoplates large and very feeble; punctures coarse and rather sparse, slightly finer toward apex. *Abdomen* finely, somewhat closely punctate, the pubescence short and very fine. *Legs* moderate in length, rather stout. Length 3.3 mm.; width 1.25 mm.

California (Los Angeles).

Represented by a single female, having a large nubilate paler spot on each elytron at about apical third. The species is distinguishable from *biguttulus* by the peculiar form of the prothorax.

A male, taken in southern California by Mr. Dunn, is placed with this species for the present, although it differs in having a relatively larger, more elongate and less medially rounded prothorax and narrower bodily form; it is similar, however, in coloration, being pale, with the head black. This specimen is the only one before me of the *biguttulus* group which has the male organs in any way protruded, and even here they are only partially visible; the copulatory sheath has the sides straight and gradually convergent at apex, the immediate tip of the latter prolonged in a narrow acute point; the excavation of the under surface continues to the extreme acute apex, becoming canaliculate along the produced spiculiform portion; the portion visible is perfectly straight in profile.

14. **A. biguttulus** Lec.—Ann. Lyc. Nat. Hist., N. Y., V, p. 155; Proc. Acad. Nat. Sci., Phila., 1852, p. 101.

Moderately broad, shorter and stouter in the female, black throughout; tarsi and antennæ toward base paler; elytra each with a small rufo-testaceous spot behind the middle, which is frequently almost obsolete; pubescence abundant, moderately long and coarse. Head subquadrate, finely but strongly, densely punctate, without impunctate line, the base broadly arcuato-truncate, not impressed; angles broadly rounded; tempora long, becoming parallel for a long distance behind the eyes, the latter moderately small, prominent; antennæ rather longer than the head and prothorax, moderately incrassate, the tenth joint distinctly longer than wide. Prothorax large, subequal in width to the head, a little longer than wide, convex, deeply, not very coarsely, extremely densely punctate, widest one-third from the apex, the sides very broadly arcuate, gradually convergent pos-

teriorly to the somewhat dilated basal margin, the latter sub-obsolete toward the middle. Elytra three-fourths longer than wide, twice as wide as the prothorax, the sides parallel and distinctly arcuate, distinctly shorter and broader in the female; omoplates large and nearly obsolete; punctures somewhat sparse and rather coarse, gradually finer toward apex. Abdomen strongly shining, though minutely and closely punctured and pubescent. Length 3.5–3.7 mm.; width 1.25 mm.

California (Santa Clara to Humboldt). Readily distinguishable from *ovicollis* by the larger, more anteriorly rounded prothorax, denser punctuation of the head and some other characters. The male has the fifth ventral but slightly longer than the fourth, unmodified and very broadly rounded behind, the genital segment coriaceous, large and wide, broadly arcuate throughout at apex and with a small rounded indentation at the middle of the disk.

Two of the specimens depart noticeably from the usual form and represent, either aberrations, or structural varieties. The first—taken in the valley of Redwood Creek, Humboldt Co., where the normal form also occurred—has the punctures throughout much coarser and sparser and the prothorax smaller, shorter, more broadly rounded at the sides, and widest only a little before the middle; the second, a unique taken in Sonoma Co., has the punctuation normal, but the prothorax is smaller, more broadly and posteriorly rounded, and the head has a narrow but distinct and entire impunctate line; they are both females.

15. **A. hastatus** n. sp.—Moderately stout, convex and polished, black; tibiae, tarsi and antennae toward base, testaceous; elytra indefinitely pale at apex; pubescence coarse, somewhat sparse, moderate in length. *Head* quadrate, convex, strongly, rather sparsely punctate, without definite impunctate line, the base broadly arcuate-truncate, not at all impressed; angles broadly rounded, the tempora long; eyes moderate; antennae as long as the head and prothorax, becoming gradually rather strongly incrassate, the tenth joint scarcely at all longer than wide. *Prothorax* nearly as wide as the head, not longer than wide, widest at apical third, where the sides are rounded, thence arcuately narrowed to the basal margin; disk convex, somewhat finely but strongly, rather sparsely punctured. *Elytra* three-fourths longer than wide, twice as wide as the prothorax, the sides parallel and almost evenly and distinctly arcuate; apex not very broadly rounded; humeri widely exposed; omoplates completely obsolete; punctures rather coarse and sparse. *Abdomen* polished, finely but only moderately closely punctured, the pubescence somewhat coarse, the legs rather short and stout; femora piceous. Length 2.8–3.0 mm.; width 0.95–1.1 mm.



Wyoming ( Green River ); Nevada ( Elko ). Mr. Wickham.

The posterior trochanters are finely spiculate posteriorly in the male, and this very distinct species is, for this reason alone, associated with *biguttulus*; that it really has but little affinity, is however shown by the male sexual characters, which are wholly different.

The fifth ventral is broadly rounded, but slightly longer than the fourth, and unmodified, the genital segment corneous, feebly and rather broadly arcuato-truncate at apex, with its surface transversely impressed posteriorly. Only the apical part of the copulatory sheath is visible, but this is modified so as to no longer serve as a protective sheath, but simply as an anchor; it consists of a slender parallel-sided shaft, having at the apex a perfect and strongly developed double barbed cordiform enlargement, the lateral lobes of which are obliquely prominent posteriorly; viewed in profile the barbed point is arcuate downward, with its extreme tip acute.

16. **A. protectus** n. sp.—Elongate, convex, polished, variable in color from pale brownish-testaceous, with or without the head black—generally male,—to black throughout the body and legs, with the antennæ paler toward base—generally female; elytra each with a small pale spot behind the middle, which is frequently obsolete; pubescence moderate in length, coarse and abundant. *Head* and antennæ nearly as in *biguttulus*. *Prothorax* large, fully as wide as the head, scarcely longer than wide, rather feebly convex on the disk, widest and broadly rounded at the sides two-fifths from the apex, the sides gradually convergent and continuously arcuate to the basal margin, which is slightly dilated laterally; disk very deeply but not coarsely, densely punctured. *Elytra* long, nearly twice as long as wide in the male, but shorter in the female, barely twice as wide as the prothorax, the sides parallel and distinctly arcuate, the convergent portion from apical two-fifths to near the tip perfectly straight; apex moderately widely subtruncate; post-scutellar impression moderate, the omoplates subobsolete; punctures coarse and sparse, scarcely less distinct toward apex. *Abdomen* finely, very densely punctate and dull, the legs somewhat stout. Length 3.5–3.8 mm.; width 1.1–1.2 mm.

California (Lake Co.).

This species is closely allied to *biguttulus*, but has the elytra longer, more obliquely and rectilinearly narrowed toward apex, the pronotal punctures rather coarser and less dense, those of the elytra somewhat stronger and relatively more obvious toward tip, the abdomen duller and more densely punctate, the prothorax of slightly different shape, and differs also in several other details.

of structure. The male has the fifth ventral much longer than the fourth.

17. **A. solidus** n. sp.—Stout, convex, shining, rufo-ferruginous, the head and elytra darker and piceous; antennæ fuscous, paler toward base; pubescence moderately long, coarse, abundant and distinct. *Head* subquadrate, slightly wider than long, convex, the outline nearly as in *biguttulus*, the punctures coarse and sparse; median impunctate line slightly evident anteriorly; eyes moderate; antennæ barely as long as the head and prothorax, somewhat incrassate, the tenth joint distinctly longer than wide. *Prothorax* large, convex, fully as wide as the head, a little longer than wide, widest and broadly rounded at apical third, the sides thence moderately and arcuately convergent to the basal margin which is slightly tumid laterally; punctures coarse deep and close but distinctly separated. *Elytra* large, two-thirds longer than wide, twice as wide as the prothorax, the sides parallel and arcuate; apex broadly rounded; disk distinctly wider in the middle than at base; humeri widely exposed, becoming transverse at the prothorax; omoplates obsolete; punctures coarse and separated by rather more than their own diameters, smaller toward apex. *Abdomen* finely, closely punctate, the punctures varying slightly in size. *Legs* rather long, the femora somewhat stout. Length 3.7 mm.; width 1.25 mm.

Arizona (Benson). Mr. G. W. Dunn.

The single female represents a species allied rather closely to *biguttulus*, but departing structurally in its stouter thicker body, and much coarser and sparser punctuation of the head and pronotum.

There is before me another female, taken by Mr. Dunn at El Paso, Texas, which I refer for the present to this species, although it differs to a great degree in color; it is black throughout, the legs paler, the pronotum paler in basal half, the elytra testaceous, with the basal margin, a large uneven median and smaller subapical fascia, black, the last two enclosing the usual pale spot, which is not at all suggested in the type of *solidus*; the prothorax, also, is noticeably shorter, being not longer than wide.

18. **A. subcalvus** n. sp.—Stout, convex, polished, intense black throughout, the tibiæ and antennæ toward base dark piceo-rufous; tarsi testaceous; pubescence of the head and prothorax moderate in length, rather sparse and coarse, the elytra completely devoid of pubescence, each puncture having at the bottom an extremely short seta, not appearing above its margin. *Head* subquadrate, a little wider than long, convex, similar in outline to that of *biguttulus*, the punctures somewhat coarse and distant, without an impunctate line; antennæ distinctly longer than the head and prothorax, gradually and

moderately incrassate, the tenth joint distinctly longer than wide. *Prothorax* scarcely narrower than the head, as long as wide, convex, widest and rather strongly rounded at anterior third, the sides thence moderately convergent and just visibly arcuate to the basal margin; punctures somewhat coarse, deep and close but distinctly separated. *Elytra* large, scarcely two-thirds longer than wide, distinctly more than twice as wide as the prothorax, evidently wider just behind the middle than at base; sides arcuate; apex not very broadly rounded; humeri widely exposed; omoplates large and subobsolete; punctures coarse, deep and well separated, but slightly smaller and more distant toward apex. *Abdomen* polished, finely, closely punctate, the metasternum more coarsely and sparsely. *Legs* rather long and slender; femora moderately stout; coxæ dark rufous. Length 3.9 mm.; width 1.35 mm.

Utah (southwestern). Mr. Weidt.

The single female represents a form closely related to *biguttulus*, but differing in the characters heretofore stated. It is possible that the elytra may have been accidentally denuded in this specimen, but it is difficult to imagine how this could have been effected so uniformly, not a single long hair remaining, except the usual series of erect tactile setæ along the flanks toward base.

19. **A. coracinus** Lec.—Proc. Acad. Nat. Sci., Phila., 1852, p. 103.

Elongate, convex, black, the tibiæ and tarsi paler; antennæ black throughout; head and prothorax glabrous, the elytra with extremely short, remote and decumbent hairs. Head subquadrate, parallel, slightly transverse, the base truncate, strongly impressed in the middle; eyes small; tempora long and parallel; angles rounded; surface moderately convex, alutaceous, finely but strongly, sparsely punctate, with a narrow and entire impunctate line; antennæ rather longer than the head and prothorax, moderately incrassate, the tenth joint not longer than wide. Prothorax distinctly narrower than the head, a little longer than wide, very convex, widest and broadly rounded at apical two-fifths, the sides thence gradually feebly convergent to a rounded feeble constriction near the base, the latter wholly devoid of beaded margin; collar broad but distinct; surface alutaceous, finely but strongly, sparsely punctured. Elytra very long, twice as long as wide, twice as wide as the prothorax, three-fourths wider than the head, the sides parallel and evenly arcuate; apex rather broadly rounded; post-scutellar impression wide and distinct; omoplates subobsolete; disk polished, sparsely, very coarsely and deeply punctured. Abdomen finely, moderately sparsely

punctate, alutaceous. Legs somewhat short and stout. Length 3.5 mm.; width 1.1 mm.

Regions near the Great Lakes. The male of this very isolated species has the posterior trochanters simple, the hind tibiae incrassate and feebly, inwardly arcuate, the fifth ventral distinctly longer than the fourth, very broadly arcuato-truncate throughout the width, the genital segment black, corneous, very broadly arcuato-truncate, polished and with a large rounded median impression.

20. **A. monticola** n. sp.—Rather stout, shining, black throughout, the tibiae and tarsi pale; pubescence coarse, cinereous, moderately short, abundant and conspicuous. *Head* large, subquadrate, moderately convex, broadly arcuato-truncate and broadly, feebly impressed at base, the angles broadly rounded into the tempora, which become parallel behind the eyes, the latter prominent, rather large, at one-half more than their own length from the base; surface somewhat finely but strongly, moderately closely punctured, with a narrow entire impunctate line; antennae not quite as long as the head and prothorax, very feebly incrassate, the tenth joint not distinctly elongate. *Prothorax* rather large, slightly narrower than the head, as wide as long, rounded on the sides anteriorly, obliquely narrowed thence to the basal margin, which is defined by a fine impressed line and dilated somewhat at the sides; punctures somewhat coarse deep and close. *Elytra* three-fourths longer than wide, perceptibly more than twice as wide as the prothorax, slightly wider at the middle than at base; apex rather broadly rounded; scutellar impression feeble; omoplates obsolete; punctures strong and somewhat close but not very coarse. *Abdomen* shining, finely, closely punctate, the pubescence short, fine and rather dense. *Legs* somewhat long and slender. Length 3.2 mm.; width 1.05 mm.

Wyoming (Laramie).

The four specimens before me do not exhibit any variation, and their sex is not apparent. This species is not comparable very closely with any other known to me.

21. **A. cephalotes** n. sp.—Rather narrow and subdepressed, polished, black, the legs piceo-rufous; pubescence moderately long, cinereous, somewhat dense and distinct. *Head* large, convex, subquadrate, slightly transverse, broadly truncate and feebly impressed at base, the angles rounded, the tempora becoming parallel at a considerable distance behind the eyes, the latter moderate in size; surface rather coarsely and densely punctate, with a narrow and entire impunctate line; antennae missing in the type, pale at base. *Prothorax* rather small, not more than three-fourths as wide as the head, not longer than wide, widest and somewhat narrowly rounded near apical fourth, the sides thence rather strongly and somewhat arcuately convergent to the feeble ante-basal constriction; basal margin defined by a fine impressed line; punctures rather fine but strong, not dense, the surface moderately convex and

highly polished. *Elytra* three-fourths longer than wide, twice as wide as the prothorax, not very obviously wider at the middle than at base, the sides parallel and very feebly arcuate; apex broadly obtuse; post-scutellar impression broad and distinct, the omoplates subobsolete; punctures strong and rather close but not very coarse. *Abdomen* feebly alutaceous, minutely punctate, moderately densely pubescent, the legs moderate. Length 2.7 mm.; width 0.8 mm.

Vancouver Island (Victoria). Mr. Wickham.

The type is a male and has rather feeble sexual characters, as far as can be observed, the fifth ventral being but slightly longer than the fourth, unmodified and broadly rounded at apex, the genital segment short, somewhat narrow, flat, corneous and black, trapezoidal in form with the apex truncate. This species is related rather closely to *punctulatus*, but is smaller, with shorter elytra, much larger head and distinctly longer and more shaggy pubescence.

22. **A. punctulatus** Lec.—Ann. Lyc. Nat. Hist., N. Y., V, p. 155; Proc. Acad., Phila., 1852, p. 100.

Moderately narrow, convex, polished, black throughout, the tibiae rufescent; tarsi paler; antennae fuscous; pubescence short, cinereous, rather abundant and distinct. Head subquadrate, moderately convex, truncate and broadly impressed at base, the angles rounded; eyes moderate; surface somewhat coarsely, closely punctate, with a smooth and entire median line; antennae moderately incrassate, the tenth joint slightly longer than wide. Prothorax distinctly narrower than the head, somewhat longer than wide, widest and broadly rounded at apical third or fourth; punctures deep, decidedly coarse and close-set. Elytra elongate fully four-fifths longer than wide, gradually narrowed and not at all broadly rounded behind; sides very feebly arcuate; omoplates large and feeble; punctures deep, rather close, moderately coarse. Abdomen shining though minutely and very densely punctate. Legs rather short and slender. Length 2.5–3.0 mm.; width 0.75–1.0 mm.

California, from the southern parts of the State to Siskiyou; also at Lake Tahoe. The pronotum is generally broadly and feebly impressed along the median line, especially anteriorly. I obtained a large series at Gilroy Springs.

The copulatory sheath is of peculiar form; it is rather stout, and, when viewed dorsally, has the sides straight and gradually

convergent from base to apex, the latter narrowly truncate, with a small and very short truncate median projection, the surface strongly and transversely convex throughout; on the under surface it is broadly and deeply excavated throughout its length, the side walls projecting inward and prominent at basal fourth; in profile the entire organ is strongly and evenly arcuate downward from base to apex. The fifth ventral is unmodified, broadly rounded at apex, the genital segment rather small, flat, short and trapezoidal.

23. **A. decrepitus** n. sp.—Moderately stout, the elytra somewhat depressed, polished, black, the entire under surface, legs and antennæ rufo-testaceous; pubescence moderate in length, somewhat dense, cinereous and conspicuous. *Head* moderate in size, quadrate, strongly convex, finely, sparsely punctate, arcuato-truncate and minutely, feebly impressed at base; angles broadly rounded; tempora long, parallel behind the eyes which are moderately large and prominent; antennæ rather short, not quite as long as the head and prothorax, somewhat incrassate, the tenth joint as long as wide. *Prothorax* small, much narrower than the head, fully as long as wide, convex, constricted in an obtuse angle at basal fourth, the sides anteriorly broadly rounded; disk widest near apical fourth, strongly but rather sparsely punctate; basal margin short. *Elytra* nearly four-fifths longer than wide, distinctly more than twice as wide as the prothorax, broadly and obtusely rounded behind, the sides parallel and feebly arcuate; subscutellar impression broad and feeble; omoplates nearly obsolete; punctures close, deep and moderately coarse; finer and feebler toward apex. *Abdomen* polished, coarsely reticulate in fine lines, the punctures very feeble. *Legs* moderate in length, slender. Length 2.4 mm.; width 0.75 mm.

Oregon (The Dalles). Mr. Wickham.

This species is remarkable, among its associates of the present group, in the form and small size of the prothorax, the constriction being at a greater distance from the base than usual; it resembles *cephalotes*, but differs greatly in its smaller head and prothorax; in *decrepitus* the basal width of the latter is almost equal to its maximum width. The sex of the single specimen in my cabinet has not been determined.

24. **A. mercurialis** n. sp.—Somewhat slender, the elytra slightly flattened, shining, dark piceous-brown or paler, the paler forms frequently with a large nubilata and slightly paler spot on each elytron at apical fourth, and also paler near the base; antennæ throughout and legs rufo-testaceous, the femora darker; pubescence stiff but short, rather abundant, pale yellowish-cinereous and distinct. *Head* subquadrate, wider than long, convex, truncate at base and broadly, strongly impressed in the middle, the angles broadly

rounded, the tempora becoming parallel; eyes moderately large and prominent; disk rather finely but strongly, closely punctate, with a very well defined entire and somewhat narrow impunctate line; antennæ slender, as long as the head and prothorax, feebly incrassate, the tenth joint fully as long as wide. *Prothorax* scarcely more than three-fourths as wide as the head, somewhat longer than wide, rounded at the sides anteriorly, finely, deeply, very densely punctate. *Elytra* somewhat more than three-fourths longer than wide, twice as wide as the prothorax, the sides parallel, evenly and feebly arcuate, the apex not very broadly rounded; scutellar impression broad and distinct, the omoplates almost obsolete; punctures strong and close, moderately coarse, very much finer toward apex. *Abdomen* alutaceous, minutely, extremely densely punctate and finely reticulate, more shining and distinctly punctate toward base. *Legs* moderately short, slender, the femora minutely and densely punctate. Length 2.9 mm.; width 0.8-0.9 mm.

California (Mendocino, Humboldt, Lake and Sonoma Cos.).

It is possible that there may be some closely allied species intermingled in the large series before me, but they cannot be advantageously separated at present. This species is closely allied to *punctulatus* and is similar in the male sexual characters, but it is somewhat more slender, with less elongate elytra, more finely and much more densely punctate head and prothorax, the latter relatively narrower, and is never black, while of the numerous specimens of *punctulatus* which I have taken, none are pale and the two forms are never found in the same locality.

The elytra are impressed along the sutural margin toward apex, especially in the male.

A single female from Tahichipi Pass is associated with *mercurialis* for the present, but it almost certainly represents a distinct and decidedly stouter species.

25. **A. cervinus** Laf.—Mon., p. 181; Lec.: Proc. Acad., Phila., 1852, p. 100.

Rufo-ferruginous, feebly shining, strongly, very densely punctate throughout, the punctures of the elytra not coarse; elytra with a transverse blackish fascia at the middle and another near the apex, enclosing a large pale spot at apical third, the maculation always more or less nubilate and frequently obsolete. Length 2.2-2.7 mm.; width 0.7-0.95 mm.

Entire United States east of the Rocky Mountains, from Idaho (Cœur d'Alène) to New York, Texas and Mississippi. This species is so common and well known that further description would be superfluous in this imperfect revision.

The copulatory sheath is long, moderately stout, only feebly arcuate from base to apex, parallel-sided and transversely convex from a dorsal point of view, gradually narrowed in a long simple ogival and not very acute point in apical third, the under surface deeply excavated throughout, the walls projecting strongly inward at basal fifth or sixth. It is thus of the same type as in *punctulatus*, but is parallel, more pointed and much less arcuate.

26. **A. gilensis** n. sp.—Moderately stout, convex, rather dull, rufo-ferruginous, the abdomen blackish; elytra with a feeble and nubilate blackish fascia at the middle and a paler subapical spot as in *cervinus*, both frequently obsolete. *Head* subquadrate, wider than long, strongly convex, finely, somewhat closely punctate, without a well-defined smooth line, the base truncate and feebly impressed; eyes large and prominent, at a little less than their own length from the base; antennæ long and rather stout, decidedly incrassate, as long as the head and prothorax, the tenth joint not quite as long as wide. *Prothorax* distinctly narrower than the head, fully as long as wide, convex, obtusely constricted at basal fifth, broadly rounded at the sides anteriorly, finely, closely punctate. *Elytra* three-fourths longer than wide, slightly more than twice as wide as the prothorax, the sides parallel and feebly arcuate; apex not very broadly rounded; punctures somewhat fine but deep and very close-set. *Abdomen* rather dull, the legs very pale; femora somewhat stout. Length 2.2–2.7 mm.; width 0.7–0.9 mm.

Arizona (Tucson).

This species is closely allied to *cervinus*, differing in its stouter and more incrassate antennæ, broader head which is broadly impressed in the middle at base, and in its still larger eyes. The copulatory sheath is nearly similar to that of *cervinus*, but is more gradually narrowed to an obtuse ogival point in more than apical half; the efferent duct is stout, but becomes rapidly and obliquely pointed toward apex.

27. **A. præceps** n. sp.—Moderately stout and convex, shining, black throughout beneath, the head and pronotum picescent; elytra dark rufo-testaceous, becoming flavate toward base, along the apical margin and in a rounded spot near apical fourth, the surface blackish before and behind the spot; antennæ and legs throughout pale flavate; pubescence cinereous, rather coarse and abundant, somewhat long on the elytra. *Head* fully as long as wide, parallel, broadly arcuato-truncate and unimpressed at base, the angles rounded; tempora becoming parallel for some distance behind the eyes, the latter moderately large, prominent; punctures fine but strong, rather close, the impunctate line feebly defined; antennæ distinctly shorter than the head and prothorax, somewhat stout, feebly incrassate, the tenth joint scarcely as long, as wide. *Prothorax* small, much narrower than the head, a little longer than



wide, convex; sides broadly rounded, obtusely constricted at basal fifth; punctures close, strong and moderately fine. *Elytra* scarcely two-thirds longer than wide, distinctly more than twice as wide as the prothorax, the sides parallel and almost evenly arcuate; apex not broadly rounded; humeri broadly exposed and transversely rounded at base; omoplates obsolete; punctures coarse, deep and rather sparse, smaller toward apex. *Abdomen* somewhat alutaceous, minutely and closely punctate, pubescent, paler at tip. *Legs* rather long and slender. Length 2.7 mm.; width 0.85 mm.

California (Mendocino Co.).

This conspicuous species bears a striking superficial resemblance to *cribratus* Lec., but belongs to the *curvinus* group, having the head truncate at base. The single male before me has very feeble sexual characters, and the spicule is not at all protruded.

28. **A. seminotatus** n. sp.—Rather narrow, moderately depressed, shining, pale rufo-ferruginous, the under surface of the hind body blackish except toward the abdominal apex; *elytra* each with a rounded and feebly defined flavescent spot at apical fourth, the adjacent surface just visibly picescent; pubescence short, moderately dense. *Head* well developed, quadrate, as long as wide, feebly convex, finely, rather closely perforato-punctate, with an ill-defined impunctate line; base truncate and unimpressed toward the middle, the angles rounded; *tempora* long, parallel, the eyes somewhat small but prominent; *antennæ* short, rather slender, feebly incrassate, the tenth joint not quite as long as wide. *Prothorax* quite distinctly narrower than the head, as long as wide, formed nearly as in *cervinus*; punctures fine and close. *Elytra* two-thirds longer than wide, scarcely twice as wide as the prothorax, the sides parallel and broadly, evenly arcuate, the apex somewhat broadly and transversely rounded; humeri rather widely exposed at base; scutellar impression feeble; omoplates subobsolete; punctures close, deep and rather small. *Abdomen* somewhat shining, the legs moderate in length, slender. Length 2.25 mm.; width 0.75 mm.

California (Los Angeles Co.).

A small species, represented by a single specimen of undetermined sex, closely allied to *cervinus*, but differing in its more depressed form, smaller size, rather smaller eyes, much shorter and more slender *antennæ* and finer, closer punctures of the anterior parts of the body.

29. **A. parallelus** n. sp.—Subparallel and somewhat depressed, rather dull, dark red-brown, the under surface throughout, legs and *antennæ* rufo-testaceous; head blackish; pubescence short, even, coarse, cinereous, dense and conspicuous. *Head* subquadrate, about as long as wide, greatly narrowed before the rather small but prominent eyes, feebly convex, somewhat coarsely,

densely punctate, without a distinct smooth line, broadly truncate and obsoletely impressed at base, the angles rounded but rather distinct; tempora parallel; antennæ slender, feebly incrassate, nearly as long as the head and prothorax, the tenth joint fully as long as wide. *Prothorax* but slightly narrower than the head, about as long as wide, somewhat strongly rounded and widest at apical fourth, the sides thence feebly convergent and just visibly arcuate to the extreme base, the margin flat and feebly defined; punctures moderate in size, deep, perforate, very dense and cribrate. *Elytra* three-fourths longer than wide, not quite twice as wide as the prothorax, the sides parallel, evenly and distinctly arcuate; apex not broadly rounded; humeri well exposed at base; omoplates subobsolete; punctures deep and very dense, moderately large. *Abdomen* shining, finely deeply and closely punctate, the apices of the segments finely impunctate. *Legs* moderate in length, the femora somewhat stout. Length 3.0 mm.; width 0.85 mm.

New Mexico (Coolidge). Mr. Wickham.

The peculiar form of the prothorax, which in this and the two succeeding species reminds us somewhat of *Vacusus*, will render the identification of them comparatively easy. The present form differs from *ancilla* in its much larger size, and in other characters which will be noted below.

30. **A. ancilla** n. sp.—Somewhat convex, moderately stout, feebly shining, black throughout, the legs rufo-piceous distally; antennæ dark rufo-testaceous throughout; pubescence somewhat short, plumbeo-cinereous, moderately dense. *Head* slightly wider than long, densely and deeply but not very coarsely perforato-punctate, the smooth line slightly visible anteriorly; base broadly truncate, feebly impressed; angles distinct but rounded; tempora parallel; eyes rather small but prominent; antennæ small, slender, shorter than the head and prothorax, feebly incrassate, the tenth joint quadrate. *Prothorax* slightly narrower than the head, as long as wide, convex, widest and rather strongly rounded at apical fourth, the sides thence moderately convergent and broadly arcuate to the basal margin; punctures fine but deep, perforate and somewhat dense. *Elytra* two-thirds longer than wide, distinctly less than twice as wide as the prothorax, parallel and feebly arcuate at the sides, the apex broadly and obtusely rounded; humeri broadly rounded to the prothorax, moderately exposed; disk decidedly convex, not coarsely but deeply, rather closely punctate, the interspaces polished; omoplates scarcely visible. *Abdomen* finely but deeply, rather closely punctate, not densely pubescent, the legs somewhat short, the femora moderately stout. Length 2.5 mm.; width 0.7 mm.

Nevada (Elko). Mr. Wickham.

The sex of the type is not determined. *Ancilla* is an ally of *parallelus*, but differs in its smaller size, more convex surface, shorter antennæ, smaller and less prominent eyes and black color.

31. **A. sodalis** n. sp.—Broad and strongly depressed, rather shining, black throughout, the femora piceous; tibiae and tarsi pale testaceous; antennae pale throughout, sometimes piceous distally; pubescence fine, short, even, plumbeous and somewhat sparse. *Head* subquadrate, slightly transverse, broadly truncate and medially impressed at base, the angles distinct but rounded; tempora short but parallel, not as long as the eyes, the latter rather large and prominent; surface polished, coarsely sparsely and somewhat unevenly punctate, with a broad uneven and entire smooth line; antennae slender but rather strongly incrassate, fully as long as the head and prothorax, the tenth joint much longer than wide, second shorter than the third or fourth, the latter equal and distinctly shorter than the fifth. *Prothorax* much narrower than the head, as long as wide, moderately convex, widest and obtusely angulate at apical fourth, the sides thence somewhat strongly convergent and straight to the basal margin; apex broadly arcuate; collar rather long, roughly sculptured, cylindrical, finely and feebly constricted at base; punctures strong but somewhat fine, dense. *Elytra* large, two-thirds longer than wide, fully twice as wide as the prothorax, just visibly wider a little behind the middle than at base; apex broadly, obtusely rounded; humeri very widely exposed; disk flat, the post-scutellar impression wide and distinct; omoplates feeble; punctures strong but not coarse, well separated. *Abdomen* broad, feebly alutaceous and reticulate, extremely minutely, closely punctate throughout, the pubescence not at all conspicuous. *Legs* rather long and slender. Length 3.1–3.2 mm.; width 1.0–1.2 mm.

Indiana.

A very distinct species, to be readily known by its broad depressed form, peculiar outline of the prothorax, coarse cephalic sculpture and other characters. It seems to lead quite naturally to the peculiar group of spotted species which follows. The sex of the two specimens before me is not determinable.

32. **A. heroicus** n. sp.—Rather stout and convex, polished, black throughout, the antennae fuscous; legs testaceous, the femora darker; each elytron with two large rufous spots, one suboval at basal fifth, the other more rounded at apical fourth; pubescence rather long, even, semi-erect, coarse, sparse but pale and conspicuous. *Head* nearly as long as wide, convex, broadly arcuato-truncate and broadly, feebly, medially impressed at base, the angles broadly rounded; eyes large, prominent, at a little less than their own length from the base; punctures fine, deep, somewhat close-set, with a wide impunctate line which is subobsolete toward base; antennae stout, incrassate, shorter than the head and prothorax, the tenth joint scarcely as long as wide. *Prothorax* quite distinctly narrower than the head, scarcely as long as wide, rounded at the sides anteriorly, obtusely constricted at basal fourth, rather coarsely, closely and strongly punctate. *Elytra* three-fourths longer than wide, twice as wide as the prothorax, the sides parallel and feebly arcuate; apex not very obtusely rounded; humeri widely exposed, becoming transverse near the

prothorax; post-scutellar impression wide and distinct; omoplates large and very feeble; punctures moderately large, strong, separated by more than their own widths. *Abdomen* dull, minutely, strongly and extremely densely punctate. *Legs* rather long, stout. Length 4.0 mm.; width 1.3 mm.

Indiana.

This is a fine species, one of the largest of the genus, and is not closely related to any other. The male has the fifth ventral feebly truncate at apex and slightly flattened on the disk toward the middle, the genital segment rather small, trapezoidal, with the somewhat narrow apex emarginate in circular arc throughout, the copulatory sheath stout, gradually narrowed to a blunt point, straight in profile, and, in general structure, very simple, resembling somewhat that of *cervinus*. Two specimens.

These quadrimaculate species form quite a distinct and natural group by themselves, and have the four elytral spots remarkably constant in form and size through long series. These spots are evidently due to protective mimicry, possibly of some species of *Bembidion*, and have therefore been gradually evolved by natural selection; their constancy is easily accounted for in this way.

33. **A. haldemani** Lec.—Proc. Acad. Nat. Sci., Phila., 1852, p. 100; *quadriguttatus* || Hald.: l. c., II, p. 304.

Scarcely stout, convex, polished, black, the legs, antennæ and, on each elytron, a large subtriangular spot at basal fourth and another smaller and rounded at apical fourth, rufous; pubescence even, cinereous, very short, subdecumbent and not dense. Head convex, wider than long, truncate and impressed at base, finely but strongly, rather closely punctate, with an entire smooth line; eyes well developed; antennæ rather stout, strongly incrassate. Prothorax much narrower than the head, as long as wide, convex, broadly rounded at the sides anteriorly, obtusely constricted at basal fourth, finely but strongly, densely punctate. Elytra three-fourths longer than wide, distinctly more than twice as wide as the prothorax, closely, deeply and moderately coarsely punctate. Length 2.7 mm.; width 0.85 mm.

Pennsylvania. There is only a single specimen before me, but I have failed to observe any variation in color, in allied species which are represented by good series, similar to that reported of this by LeConte, and think there must have been some confusion of species.

34. **A. stellatus** n. sp.—Somewhat stout and convex, shining, black, the legs and antennæ dark rufous, with the femora darker, each elytron with a large pale spot in basal fifth and another smaller and rounded at apical fourth; pubescence short, coarse, semi-erect, even, cinereous and rather dense, the hairs of the head and, to some extent, of the pronotum arcuate and thickened at apex. *Head* large, quadrate, convex, truncate and strongly, medially impressed at base; angles rounded; tempora parallel, longer than the eyes, the latter moderately developed and prominent; surface strongly, closely punctate, the smooth medial line ill-defined toward base; antennæ rather slender, nearly as long as the head and prothorax, moderately incrassate, the tenth joint somewhat wider than long. *Prothorax* scarcely more than three-fourths as wide as the head, not longer than wide, broadly rounded at the sides anteriorly, sinuate at basal fourth, convex, finely but strongly, densely punctate. *Elytra* large, two-thirds longer than wide, much more than twice as wide as the prothorax, distinctly wider at a little behind the middle than at base, broadly rounded behind, gradually dehiscent in apical fifth or sixth; humeri moderately exposed; scutellar impression rather narrow and distinct; omoplates subobsolete; punctures deep but not very large, separated by about their own widths. *Abdomen* dull, minutely, closely punctate, also minutely reticulate. *Legs* somewhat long and slender. Length 3.2 mm.; width 1.1 mm.

Wyoming (Laramie).

The only species to be compared with this is the Californian *auriger*, which differs in its much less obese form and in its smaller head, in addition to coloration.

35. **A. auriger** n. sp.—Not stout, rather convex, shining, black throughout, the femora black; tibiæ and tarsi abruptly pale flavate; antennæ dark rufo-testaceous; each elytron with two rounded flavate spots, one slightly larger at basal fifth, the other at apical fourth; pubescence short, semi-erect, cinereous, moderately close, the hairs of the head and pronotum clavate and recurved, those of the elytra simple. *Head* quadrate, fully as long as wide, convex, truncate and medially impressed at base; angles distinct but broadly rounded; tempora long, feebly convergent behind the eyes, the latter moderately developed and prominent; punctures strong but not very large and rather close-set, the smooth line obliterated toward base; antennæ about as long as the head and prothorax, somewhat thick and strongly incrassate, the tenth joint not quite as long as wide. *Prothorax* much narrower than the head, as long as wide, obtusely constricted at basal fourth, the sides broadly rounded anteriorly, widest at apical fourth; collar well developed, finely but very deeply constricted at base; punctures fine, deep and close. *Elytra* three-fourths longer than wide, twice as wide as the prothorax, the sides subparallel and feebly arcuate; apex narrowly rounded; humeri broadly exposed at base; scutellar impression feeble but distinct; omoplates large and feeble; punctures deep, very close-set, moderately coarse, becoming very fine toward apex. *Abdomen* alutaceous, minutely, densely punctate, the legs rather long and slender; coxæ pale. Length 2.8–3.2 mm.; width 0.9–1.0 mm.

California (middle coast regions).

The male has the fifth ventral unmodified, the genital segment small, short, pale and coriaceous, trapezoidal, with the apex feebly emarginate throughout the width, the bottom of the emargination broadly straight and transverse; the copulatory sheath is rather less densely corneous than usual, dorsally it is gradually narrowed to an obtuse and simple point, with the surface impressed along the median line except near the apex, widely excavated along the under surface, straight in profile but narrowed near the distal extremity above and beneath, the prolongation being feebly swollen toward its rounded apex. This species occurred in large numbers at Gilroy Springs, together with *punctulatus*, and there is no discernible variability.

36. **A. saucius** n. sp.—Somewhat stout, convex and dull, black, the legs and antennæ throughout and, on each elytron, a large oval spot at basal fourth and another, large but rounded, at apical fourth, rufous; pubescence rather dense, cinereous, short, clavate and recurved everywhere on the upper surface except toward the front of the head and narrowly along the elytral suture, where the hairs become longer and simple. *Head* as long as wide, thick and convex, truncate and medially impressed at base, the angles broadly rounded; eyes large and prominent, the tempora scarcely as long and feebly convergent behind them; disk finely but rather closely punctate, the smooth line not distinct toward base; antennæ fully as long as the head and prothorax; strongly incrassate, the tenth joint about as long as wide. *Prothorax* distinctly narrower than the head, as long as wide, convex, obtusely constricted at basal fourth, somewhat finely but deeply, densely punctate. *Elytra* large, three-fourths longer than wide, distinctly more than twice as wide as the prothorax, broadly rounded behind, the sides parallel and feebly arcuate; humeri widely and transversely exposed at base; omoplates subobsolete; punctures dense and deep, moderately large. *Abdomen* alutaceous, minutely and densely punctate. *Legs* somewhat long and slender. Length 3.0 mm.; width 1.1 mm.

Iowa (Keokuk).

The sexual characters of the male are simple, the copulatory sheath being elongate, parallel, gradually narrowed in apical third to a very obtusely rounded and simple point, the surface unusually flat, perfectly straight and thin in profile, excavated throughout its length beneath. A single male.

37. **A. vulneratus** n. sp.—Subparallel, strongly depressed, dull, black or piceous-black; abdomen pale toward tip; legs throughout pale flavate; antennæ rufo-testaceous; each elytron with a large elongate-elliptical testaceous spot at basal fourth, and another much smaller and rounded at apical fourth; pubescence of the elytra short, even, dense, coarse but not clavate, of

the pronotum and basal parts of the head short and clavate. *Head* rather large, moderately convex, fully as wide as long, finely but strongly, densely punctate, with the smooth line uneven, truncate and with a deep canaliculiform impression at base, the angles broadly rounded; tempora slightly divergent and feebly arcuate to the eyes, the latter somewhat longer than the tempora, large and prominent; antennae rather longer than the head and prothorax, moderately incrassate, the tenth joint as long as wide. *Prothorax* much narrower than the head, fully as long as wide, rounded at the sides, obtusely constricted at basal fourth, moderately convex, strongly and closely punctate. *Elytra* two-thirds to three-fourths longer than wide in the female and male respectively, slightly dilated behind the middle in the former, subparallel in the latter and more obtusely rounded at apex; scutellar impression distinct; omoplates subobsolete; surface strongly, densely and moderately coarsely punctate. *Abdomen* dull, densely and finely sculptured, smooth and densely punctate near the base. *Legs* somewhat long and slender. Length 3.0-3.25 mm.; width 0.9-1.05 mm.

Southern Arizona.

The male has quite distinct sexual characters, the apex of the fifth ventral being broadly but strongly sinuate in circular arc.

The four specimens before me are perfectly constant in the pattern of coloration.

38. **A. junctus** n. sp.—Subparallel, rather depressed, slightly shining, black, the prothorax frequently entirely or partially testaceous; legs pale, the femora sometimes darker; antennae testaceous; elytra with a large pale area in basal fourth to third, evidently formed by the union of two large spots, each elytron also having a rounded pale spot at apical fourth; pubescence short, nearly as in *vulneratus*. *Head* somewhat large, moderately convex, shining, strongly, closely punctate with the smooth line imperfect toward base, the latter truncate, impressed at the middle, the angles rounded; eyes rather small, convex, very much shorter than the tempora, the latter parallel, then gradually rounded into the base; antennae fully as long as the head and prothorax, rather strongly incrassate, the tenth joint about as long as wide. *Prothorax* much narrower than the head, as long as wide, obtusely constricted at basal fourth, somewhat strongly rounded and widest at apical fourth, finely but strongly, rather closely punctate. *Elytra* two-thirds longer than wide, twice as wide as the prothorax, slightly wider behind the middle than at base, the sides feebly arcuate; apex rather broadly rounded; humeri broadly exposed; scutellar impression strong; omoplates scarcely visible; disk somewhat depressed, densely, strongly and rather coarsely punctate. *Abdomen* alutaceous, minutely, densely punctate, the legs rather long and slender. Length 3.25-3.5 mm.; width 0.95-1.1 mm.

New Mexico (Las Vegas); Arizona.

The male has the fifth ventral much longer than the fourth, rather broadly truncate at apex, the genital segment small, pale, coriaceous, transversely and evenly convex, with an abrupt, deep

and trapezoidal apical emargination more than twice as wide as deep, the margins of which are narrowly thin, whitish and membranous. In the female the fifth ventral is shorter, scarcely longer than the fourth and broadly truncate at apex.

The six specimens in my cabinet show more tendency to vary in color than in *vulneratus*, in one example the basal pale area spreading feebly along the suture posteriorly, and the pronotum varying from intense black to pale testaceous; the male sexual characters and smaller eyes will distinguish it at once from *vulneratus*, which is the only species which is at all similar.

39. **A. decorellus** n. sp.—Somewhat stout, moderately convex, dull, piceous-black, the head and elytra blacker than the prothorax; legs pale throughout; antennæ fuscous, paler toward base; pubescence short, even, coarse, dense, cinereous and conspicuous, clavate and recurved on the pronotum and basal parts of the head. *Head* large, truncate at base, with a deep canaliculate median impression; basal angles broadly rounded; eyes large and prominent, distinctly longer than the tempora, the latter feebly convergent and arcuate behind them; disk not coarsely but strongly and densely punctate, the smooth line imperfect; antennæ rather slender and feebly incrassate, barely as long as the head and prothorax, the tenth joint as long as wide. *Prothorax* small, as long as wide, scarcely three-fourths as wide as the head, evenly convex, parallel and broadly rounded anteriorly, widest near anterior third, obtusely and angularly constricted somewhat before basal fourth; punctures rather fine but deep and extremely dense. *Elytra* two-thirds longer than wide, nearly two and one-half times as wide as the prothorax, the sides parallel, broadly, almost evenly arcuate, the apex not very broadly rounded; humeri widely exposed; omoplates subobsolete, the scutellar impression rather narrow and distinct; punctures somewhat fine, deep, very dense. *Abdomen* finely, closely punctate, the legs somewhat long, slender. Length 3.2 mm.; width 1.15 mm.

Texas.

The elytra have each a very large pale spot, extending from near the extreme base to the middle, where it is united with another large elongate-oval spot extending to apical eighth. The single specimen is a female, separable at once from *junctus* by the large eyes, and readily distinguishable from *vulneratus*, which it more closely resembles, by the relatively smaller prothorax, much denser punctuation throughout, and rather shorter and broader elytra, in addition to the distinct ornamentation.

40. **A. nanus** Lec.—Ann. Lyc. Nat. Hist., N. Y., V, p. 156; Proc. Acad., Phila., 1852, p. 101.

Rather narrow, convex, shining, pale testaceous throughout



except the entire abdomen, which is black; elytra sometimes feebly infusate toward the middle; pubescence coarse, moderately long and abundant. Head subquadrate, truncate but scarcely at all impressed at base, the angles narrowly rounded; tempora parallel, rather longer than the eyes which are moderate in size and convexity; surface coarsely and unevenly punctate, the punctures very sparse toward the broad smooth line, but closer and with the interspaces reticulate toward the sides; antennæ short, slender, very feebly incrassate, scarcely as long as the head and prothorax, the tenth joint a little wider than long. Prothorax subequal in width to the head, short, scarcely as long as wide, the sides feebly oblique and straight posteriorly; disk somewhat finely but strongly, rather unevenly punctate, the punctures generally well separated. Elytra barely two-thirds longer than wide, twice as wide as the prothorax, the sides parallel and evenly arcuate; apex rather obtusely rounded; humeri moderately exposed at base, broadly rounded; disk somewhat convex and finely but strongly punctate, the punctures close but distinctly separated. Length 1.75 mm.; width 0.65 mm.

California (San Diego). This is one of the smallest species of the genus.

41. **A. vagans** n. sp.—Somewhat narrow, moderately convex, shining, pale flavo-ferruginous throughout, the pubescence stiff, moderately long and abundant, subdecumbent. Head subquadrate, feebly convex, truncate and unimpressed at base, the angles rather broadly rounded; tempora parallel and distinctly longer and nearly as prominent as the eyes, the latter moderate in size and not very convex; punctures very coarse, sparse, scarcely closer and with the interspaces highly polished toward the sides; antennæ somewhat slender, very gradually and feebly incrassate, distinctly shorter than the head and prothorax, the tenth joint slightly transverse. Prothorax trapezoidal, much narrower than the head, not quite as long as wide, widest and narrowly rounded at apical fourth, the sides thence moderately convergent and straight to the base; disk rather coarsely, deeply, evenly and densely punctate. Elytra three-fourths longer than wide, fully twice as wide as the prothorax, the sides parallel and broadly, feebly arcuate; apex moderately broadly rounded; humeri well exposed and rounded; scutellar impression and omoplates completely obsolete; punctures deep and somewhat dense, not much larger than those of the pronotum. Abdomen finely and rather sparsely punctate, scarcely darker in color, the legs very slender, moderate in length. Length 1.9–2.2 mm.; width 0.6–0.7 mm.

Idaho (Cœur d'Alène); Montana; Wyoming (Laramie). Mr. Wickham.

Some specimens have the abdomen, head and a feeble median elytral fascia darker. The male sexual characters seem to be very feeble, the fifth ventral unmodified, the genital segment short, broad, pale and coriaceous, flat and broadly, feebly truncate at apex. The large series before me displays but little variability, and the species may be readily known from *nanus* by its larger size and relatively much larger head.

42. **A. peninsularis** n. sp.—Moderately stout, convex, shining, pale flavo-ferruginous throughout, the abdomen piceous; pubescence pale, moderately long and abundant, subrecumbent. *Head* small, subquadrate, slightly wider than long, transversely truncate and rectilinear at base throughout the width, with a feeble median impression on the vertical base of the occiput; angles right and narrowly rounded; eyes rather large, prominent, much longer than the tempora, the latter parallel, less prominent and rectilinear; punctures coarse, sparse, scarcely closer and with smooth interspaces laterally; antennæ as long as the head and prothorax, very feebly and gradually incrassate, the tenth joint subquadrate. *Prothorax* rather large, fully as wide as the head, not quite as long as wide, narrowly and subangularly rounded at apical fifth, the sides thence oblique and straight to the base; apex broadly, evenly arcuate, punctures strong and not very close-set. *Elytra* two-thirds longer than wide, not quite twice as wide as the prothorax, the sides parallel, sensibly and almost evenly arcuate, the apex somewhat broadly rounded; humeri only moderately exposed and broadly rounded; scutellar impression and omoplates completely obsolete; punctures strong but not very coarse, close-set. *Abdomen* finely, rather closely punctate and coarsely pubescent, the legs moderate in length, slender. Length 1.8 mm.; width 0.7 mm.

#### Lower California.

The male has simple sexual characters, the fifth ventral being unmodified, the genital segment short, coriaceous and subtruncate at apex; only the tip of the copulatory sheath is exposed in the type, but this is stout and rather rapidly narrowed to an obtuse ogival or parabolic point, the under surface deeply excavated throughout the width to the apex.

This species is closely allied to *nanus*, but differs abundantly in its somewhat larger size, denser punctuation, much larger eyes, more rectilinearly truncate head and relatively larger prothorax.

43. **A. nympha** n. sp.—Shining, pale flavo-ferruginous throughout, moderately convex; pubescence of the head very sparse but long, coarse and distinct, of the pronotum shorter and more abundant, of the elytra suberect, rather long, coarse and moderately dense. *Head* subquadrate, a little wider than long, truncate at base, the angles right, somewhat narrowly rounded; eyes rather large and convex, longer and more prominent than the tempora,

which are straight and parallel to the basal angles; punctures coarse, very sparse, subrugose, with the usual broad impunctate line; antennæ slender, one-half longer than the head, quite distinctly incrassate toward apex, the tenth joint much wider than long. *Prothorax* scarcely perceptibly narrower than the head, distinctly wider than long, trapezoidal, very narrowly and subprominently rounded at apical fourth or fifth, the sides thence oblique and straight to the base; apex very broadly arcuate; disk finely, sparsely punctate. *Elytra* unusually short, scarcely more than one-half longer than wide, twice as wide as the prothorax, suboval, the sides parallel, evenly and rather strongly arcuate; apex moderately obtuse; humeri broadly rounded to the prothorax, moderately exposed at base; disk somewhat feebly convex, the post-scutellar impression very small and feeble; omoplates obsolete; punctures fine but strong, rather close-set. *Abdomen* minutely, obscurely punctate, more distinctly and sparsely so toward base, the legs rather long, very slender. Length 1.75 mm.; width 0.6 mm.

Texas (Columbus). Hubbard and Schwarz.

This exceedingly small and fragile species is evidently allied rather closely to *nanus* and other species of this group, with peculiarly coarsely and rugosely punctured head, but may be readily known from any of them by the shorter and suboval elytra, and more clavate antennæ. It is represented in my cabinet by a single male, having very feeble sexual characters.

44. **A. obliquus** n. sp.—Somewhat stout, the elytra slightly depressed, shining, pale flavo-ferruginous throughout, the abdomen sometimes blackish; pubescence rather short, even, sparse on the head, very dense on the pronotum and moderately dense on the elytra. *Head* subquadrate, slightly wider than long, transversely truncate at base, very feebly impressed at the middle of the basal wall; angles somewhat broadly rounded, the tempora gradually becoming straight and parallel for a short distance behind the eyes, the latter rather large and convex, longer and more prominent than the tempora; punctures very coarse and sparse, the surface feebly reticulate especially toward the sides; antennæ barely as long as the head and prothorax, very feebly incrassate. *Prothorax* rather large, just visibly narrower than the head, not quite as long as wide, somewhat narrowly rounded but not at all angulate at apical fifth, the sides thence straight and oblique to the base, transversely arcuate at apex; disk finely, deeply and very closely punctate. *Elytra* large, two-thirds longer than wide, fully twice as wide as the prothorax; sides parallel, broadly and feebly arcuate, rather obtusely rounded at apex; humeri widely and transversely exposed at base; scutellar impression visible but broad and feeble; omoplates obsolete; punctures rather fine but deep, moderately close-set. *Abdomen* finely but not very closely punctate, the punctures rather strong toward base; pubescence somewhat short and coarse, the legs moderately long, very slender. Length 2.0–2.1 mm.; width 0.75–0.8 mm.

California (San Diego).

I took a single pair at the locality indicated ten years ago, and place with these examples a specimen subsequently received from Los Angeles Co., which agrees apparently in every particular, but which is in rather bad condition. The male characters are very simple, the fifth ventral being unmodified, the genital segment trapezoidal, feebly convex and polished, with the apex feebly arcuato-truncate and fringed with rather long, stiff and porrect cilia.

*Obliquus* differs from both *nanus* and *peninsularis* in its larger size, finer, denser punctures of the pronotum, and, especially, in its much longer, wider and less convex elytra, with the humeri more broadly and transversely exposed at base.

45. **A. innocens** n. sp.—Narrow, moderately convex, shining, pale flavo-ferruginous throughout, except the abdomen, which is blackish; pubescence rather coarse and close, but short, longer but very sparse, somewhat fine and inconspicuous on the head. *Head* subquadrate, a little wider than long, broadly, feebly arcuato-truncate at base, the angles distinctly rounded; eyes rather large and convex, decidedly longer and more prominent than the tempora, which are straight and parallel behind them for a short distance; punctures coarse, sparse and rugose, the surface polished throughout; antennae nearly as long as the head and prothorax, feebly and gradually thickened, the tenth joint but slightly wider than long. *Prothorax* rather small, distinctly narrower than the head, not quite as long as wide, trapezoidal, narrowly rounded near the apex, the sides thence oblique and straight to the base; apex broadly arcuate; disk somewhat finely but strongly, closely punctate. *Elytra* two-thirds longer than wide, twice as wide as the prothorax, not very broadly rounded behind, the sides parallel, broadly, feebly, almost evenly arcuate; humeri rather widely and transversely exposed at base, rounded externally; scutellar impression and omoplates obsolete; punctures fine but strong and somewhat close-set; disk with a narrow and deep impression along each side of the suture posteriorly, not attaining the apex. *Abdomen* minutely, not densely punctate, the legs moderate in length, very slender. Length 1.85 mm.; width 0.65 mm.

Arizona (Peach Springs). Mr. Wickham.

A very small and delicate species, resembling *nanus*, but differing in its larger eyes and relatively larger head.

46. **A. insecitus** n. sp.—Moderately narrow, convex, shining, black throughout, the prothorax slightly rufescent; legs and antennae dark rufo-testaceous; pubescence cinereous, moderately long and dense, subdecumbent and distinct. *Head* subquadrate, slightly wider than long, rather convex, transversely truncate and feebly, medially impressed at base; eyes somewhat large and convex, slightly longer than the tempora, the latter perceptibly swollen posteriorly and quite as prominent as the eyes; disk polished, coarsely, rather

sparsely punctate, with the usual impunctate line wide toward the front; antennæ not as long as the head and prothorax, rather slender, gradually and scarcely perceptibly incrassate, the tenth joint but slightly wider than long. *Prothorax* very slightly narrower than the head, about as long as wide, narrowly rounded but not at all angulate at apical fourth, the sides thence oblique and straight to the base; apex broadly arcuate; disk convex, not coarsely but deeply, very closely punctate. *Elytra* large and long, three-fourths longer than wide, fully twice as wide as the prothorax, semi-circularly rounded behind, very slightly wider behind the middle than at base; humeri broadly and transversely exposed at base; post-scutellar impression broad and feeble, the omoplates obsolete; punctures close, deep and moderately large. *Abdomen* somewhat strongly shining, minutely, closely punctate, finely pubescent, the legs moderate in length and very slender. Length 2.1–2.2 mm.; width 0.7–0.75 mm.

California (near San Francisco and in Humboldt Co.); Nevada (Reno).

Evidently allied to *nanus*, but much larger, with distinct cephalic structure, denser sculpture, longer elytra and different coloration. I have seen only a single female from each of the three localities.

At each side of the front, near the point of antennal insertion, there is a small pale impunctate spot of doubtful significance, but possibly a point where the condyle of the basal joint thins out the upper surface; it is, however, at a considerable distance from the antennal foramen, and does not appear to be connected in any way with that organ.

47. **A. amœnus** n. sp.—Moderately stout, somewhat shining, piceotestaceous, the head and abdomen frequently darker; elytra generally with a broad and nubilata median fascia; pubescence of the head long but sparse and inconspicuous, of the pronotum shorter, decumbent, pale cinereous, dense and distinct, of the elytra similar but less dense. *Head* rather small, slightly wider than long, transversely truncate but scarcely at all impressed at base, the angles broadly rounded; eyes moderate, not very convex and not quite as long as the tempora, the latter parallel and feebly arcuate, gradually curving into the base; punctures coarse, deep and only moderately sparse, the wide median smooth line somewhat irregular; antennæ not quite as long as the head and prothorax, feebly incrassate, the tenth joint subquadrate. *Prothorax* very slightly narrower than the head, about as long as wide, rather narrowly but not angularly rounded at apical fourth, the sides thence oblique and straight to the base; disk somewhat finely but deeply and densely punctate. *Elytra* three-fourths longer than wide, twice as wide as the prothorax, circularly rounded at apex, the sides parallel and feebly arcuate; humeri widely and transversely exposed at base, rounded externally; scutellar impression very broad and feeble, the omoplates obsolete; punctures rather fine and close-set.

*Abdomen* somewhat sparsely punctate toward base, the legs very slender. Length 1.9–2.2 mm.; width 0.65–0.7 mm.

California (Lake Co.).

The large series in my cabinet shows that this is a species differing from *nanus* in its larger size, much denser sculpture and deeper color, and, from *inscitus*, in its smaller eyes, longer and parallel tempora, denser cephalic punctures and less convex elytra. I have before me a single specimen from Alameda Co., which is much stouter than any of those from the above locality (2.4 by 0.85 mm.), with dense abdominal punctures, and a cloud on each elytron not extending to the suture; it probably represents a closely allied species.

48. **A. obscurellus** Lec.—Ann. Lye. Nat. Hist., N. Y., V, p. 155; Proc. Acad., Phila., 1852, p. 101.

Narrow, convex, shining, dark red-brown, the elytra frequently picescent and the under surface of the hind body black; pubescence moderately short, coarse and dense. Head distinctly wider than long, convex, finely, rather closely punctate, with a narrow smooth line, truncate at base, the angles rounded; tempora long and parallel; eyes very small but prominent; antennæ somewhat stout, feebly incrassate, not quite as long as the head and prothorax. Prothorax convex, about as wide as the head, as long as wide, broadly rounded anteriorly, the sides gradually convergent, becoming less arcuate to a feeble subbasal constriction; punctures fine and deep, but not very close-set. Elytra elongate, suboval, convex, three-fourths longer than wide, quite distinctly less than twice as wide as the prothorax; humeri rather narrowly exposed and rounded; punctures small but strong and close-set. Abdomen finely and sparsely punctate, alutaceous, polished at base. Legs rufo-testaceous, slender. Length 1.8 mm.; width 0.6 mm.

California (San José and San Francisco) and Oregon (The Dalles). This is a very small and rather remarkable species, which is probably more nearly related to *cervinus* than to those with which it is here associated. The fifth ventral of the male is unmodified; the genital segment is large, coriaceous, very broadly arcuate throughout its width, not impressed; the copulatory sheath seems to terminate in a slender parallel-sided shaft which is abruptly and transversely enlarged at tip but scarcely barbed.

49. **A. militaris** n. sp.—Moderately narrow, the elytra rather depressed, shining, black, the legs, antennæ and a large humeral spot on each elytron rufo-testaceous; pubescence somewhat coarse, cinereous, moderately short and sparse. *Head* rather large, quadrate, as long as wide, truncate at base, the angles rounded; eyes small but prominent, the tempora long and parallel behind them; punctures somewhat small but strong, close-set, the median impunctate line uneven, obliterated toward base; antennæ moderate in length, rather distinctly incrassate, the tenth joint wider than long. *Prothorax* very much narrower than the head, somewhat longer than wide, convex, narrowly rounded but not at all angulate at apical fourth, the sides thence oblique and subsinuate to the basal margin; punctures fine but strong, moderately dense. *Elytra* barely two-thirds longer than wide, twice as wide as the prothorax, obtusely subtruncate at apex, the sides parallel and feebly arcuate; humeri widely and transversely exposed at base; scutellar impression and omoplates subobsolete; punctures rather small but deep and somewhat dense, very minute toward apex. *Abdomen* finely, sparsely punctate, the legs slender, with the femora darker and more rufous than the tibiæ and tarsi. Length 2.2 mm.; width 0.7 mm.

California (Tahichipi Pass). Mr. Wickham.

The single specimen appears to be a female. This species is quite isolated and cannot be compared with any other known to me.

50. **A. bellulus** Lec.—Ann. Lyc. Nat. Hist., N. Y., V, p. 156; Proc. Acad., Phila., 1852, p. 101.

Moderately stout and convex, alutaceous, pale rufo-testaceous, the entire under side of the hind body, a broad median fascia on the elytra and another narrow and frequently obsolete at the apex, connected at the sides with the median fascia, black, the basal margin of the elytra rarely blackish, and the head darker than the prothorax; pubescence very short, even, moderately dense. Head convex, quadrate, the eyes small. Prothorax small, distinctly narrower than the head, not as long as wide, rounded anteriorly, the sides thence oblique and broadly sinuate to the basal margin; punctures very fine and dense. Elytra two-thirds longer than wide, distinctly more than twice as wide as the prothorax, obtusely subtruncate at apex; humeri widely exposed at base; punctures fine, deep and dense. Length 1.8–1.9 mm.; width 0.65–0.7 mm.

California (Lake Co. and San Diego), Nevada (Reno), Arizona (Riverside) and Texas (San Antonio). A very widely distributed species, easily known by its small size, very short and even pubescence, and sharply defined fascia of black, which is,

however, sometimes almost obsolete. The copulatory sheath seems to have a simple obtusely ogival point.

51. **A. helvinus** n. sp.—Rather narrow, subparallel and depressed, dull, pale ochreo-flavate throughout above and beneath; pubescence even, suberect, very short, coarse, dense, the hairs strongly and posteriorly arcuate. *Head* large, quadrate, as long as wide, truncate and unimpressed at base, the angles rather broadly rounded; eyes moderately small and convex, about three-fourths as long as the tempora, the latter parallel and very feebly arcuate; disk somewhat finely but strongly, very densely punctate, the narrow impunctate line obliterated toward base; antennæ about as long as the head and prothorax, feebly incrassate, the tenth joint wider than long. *Prothorax* rather small and very feebly convex, much narrower than the head, not quite as long as wide, narrowly rounded but not angulate near the extreme apex, the sides oblique and very feebly sinuate thence to the base, the basal margin narrow and feebly defined; punctures somewhat small but deep and extremely dense, the interspaces dull and reticulate. *Elytra* three-fourths longer than wide, fully twice as wide as the prothorax, obtusely rounded behind; sides parallel and very feebly arcuate; humeri rather widely exposed at base, the scutellar impression and omoplates subobsolete; disk depressed, very deeply and densely punctate, the punctures moderately large. *Abdomen* finely and indistinctly punctate, alutaceous, the legs very slender. Length 2.2 mm.; width 0.7 mm.

California (Lake Co.).

The single female represents a very distinct species, which may be known by its depressed and subparallel form, dull lustre, extremely dense and not very fine punctuation, and unusually short, peculiarly recurved pubescence.

52. **A. lutulentus** n. sp.—Moderately narrow, somewhat strongly convex, shining, pale ochreo-flavate throughout above and beneath; pubescence moderately long, coarse, subdecumbent, even, not very dense. *Head* subquadrate, as long as wide, arcuato-truncate at base, the angles rather broadly rounded; eyes somewhat large and prominent, about as long as the tempora, the latter subparallel behind them for a short distance; disk finely, somewhat sparsely punctate, with a narrow but apparently entire impunctate line; antennæ about as long as the head and prothorax, feebly incrassate, the tenth joint rather wider than long. *Prothorax* quite distinctly narrower than the head, almost as long as wide, rather narrowly rounded at apical fourth, the sides thence oblique and nearly straight to the base, the margin just visibly dilated laterally; apex broadly, somewhat strongly arcuate; punctures fine but deep, well separated. *Elytra* two-thirds longer than wide, fully twice as wide as the prothorax, not broadly, circularly rounded at apex, the sides parallel and feebly arcuate; humeri not very widely exposed, rounded; scutellar impression and omoplates obsolete; punctures small but deep and close-set. *Legs* moderate in length, rather slender. Length 2.0–2.3 mm.; width 0.65–0.75 mm.



Texas (Austin and Waco).

With the typical forms of this species, I have placed numerous aberrant or varietal forms from New Mexico, Iowa and Montana; some of them are larger and stouter with longer pubescence; others have a large piceous cloud on the elytra. There certainly seem to be some closely allied but distinct species involved, which can only be successfully studied with larger series from numerous localities.

53. **A. agilis** n. sp.—Moderately narrow and convex, polished, black throughout, the legs dark piceo-rufous; antennæ paler rufo-testaceous; pubescence long, coarse, cinereous, somewhat dense and very conspicuous, subdecumbent. *Head* subquadrate, as long as wide, broadly, very feebly arcuato-truncate, the angles moderately rounded; eyes somewhat small, not very convex, much shorter than the tempora; disk strongly and very closely punctate, the narrow impunctate line almost obliterated toward base; antennæ only one-half longer than the head, quite distinctly incrassate, the tenth joint slightly transverse. *Prothorax* rather large, subequal in width to the head, very nearly as long as wide, narrowly rounded at apical fourth or fifth, the sides oblique and straight thence to a very feeble and obtuse subbasal constriction; apex transversely truncate, rounded laterally; disk strongly and very densely punctate. *Elytra* elongate, fully three-fourths longer than wide, twice as wide as the prothorax, moderately obtuse at apex; sides parallel and feebly arcuate; humeri broadly rounded to the prothorax; scutellar impression and omoplates obsolete; punctures rather small but deep, well separated. *Abdomen* polished, finely and closely but distinctly punctured throughout, the legs somewhat long and slender. Length 2.4 mm.; width 0.8 mm.

Wyoming (Green River). Mr. Wickham.

Allied somewhat closely to *herifuga*, but differing in its larger size, more elongate elytra, wider prothorax which is more narrowly rounded at a point much nearer the apex, more transversely truncate head and several other features.

54. **A. herifuga** n. sp.—Not stout, somewhat depressed, polished, black, the prothorax slightly paler, especially toward base; legs and antennæ pale piceo-testaceous; pubescence long, subdecumbent, cinereous, coarse, rather abundant and very conspicuous. *Head* somewhat small, subquadrate, fully as long as wide, the base broadly and distinctly arcuate, the angles obvious but broadly rounded; eyes rather small and not very prominent, much shorter than the tempora, the latter parallel behind them for some distance, gradually curving into the base; disk strongly, very closely punctate; antennæ almost as long as the head and prothorax, the outer four joints distinctly though gradually enlarged, the tenth slightly transverse. *Prothorax* small, distinctly narrower than the head, not as long as wide, rather broadly rounded at apical fourth, the sides thence oblique and straight to the basal margin which is

slightly dilated and thickened laterally; apex broadly arcuate; punctures strong and very close-set, the interspaces polished. *Elytra* short, scarcely two-thirds longer than wide, broadly rounded at apex, the sides parallel and very feebly arcuate; humeri somewhat widely and transversely exposed at base; scutellar impression very feeble, the omoplates obsolete; disk densely and deeply but only moderately coarsely punctate. *Abdomen* polished, finely, closely punctate, the legs very slender. Length 2.0 mm.; width 0.7 mm.

#### California

This small and inconspicuous species is sufficiently differentiated from the preceding by its short elytra, small and more rounded prothorax, and other characters as heretofore stated. I have placed with the California type, taken by Mr. Wickham, two pale specimens, one with nubilata elytra taken in the southern part of the State by Mr. Dunn, also a specimen taken at Pocatello, Idaho, by Mr. Wickham, which has the pubescence still longer and more shaggy, and finally a larger blackish specimen from New Mexico.

The species in this particular part of the series are so closely allied and apparently so indefinite, that I can only select at present a few of the more obviously distinct ones for description as landmarks; much more extensive material will be required to enable the future reviewer to fully differentiate them.

55. **A. mundus** n. sp.—Moderately narrow and convex, shining, rufo-testaceous, the entire under surface of the hind body black; elytra black, with two large humeral areas meeting near the scutellum, and two oblique oval apical spots meeting on the suture at apex, of pale rufo-testaceous; pubescence rather long, coarse, cinereous and conspicuous. *Head* subquadrate, convex, somewhat wider than long, minutely and not densely punctured, with a narrow impunctate line, broadly arcuate at base; eyes moderate in size but prominent, not as long as the tempora, the latter nearly straight and perceptibly convergent from the eyes to the basal angles, which are obtuse but only narrowly rounded; antennæ slightly shorter than the head and prothorax, very feebly incrassate, joints eight to ten, abruptly much shorter than the preceding, equal in length, the tenth not as long as wide. *Prothorax* small, distinctly narrower than the head, not as long as wide, narrowly rounded at apical fourth, the sides thence oblique and straight to the basal margin; disk rather finely but deeply, not very closely punctate. *Elytra* two-thirds longer than wide, twice as wide as the prothorax, the sides parallel and feebly arcuate; apex not broadly rounded; humeri widely and transversely exposed at base; post-scutellar impression somewhat narrow and distinct; omoplates obsolete; disk strongly but not coarsely, rather densely punctured. *Abdomen* polished, finely punctate, the legs very slender. Length 2.1 mm.; width 0.75 mm.

Wyoming (Laramie). Mr. Wickham.

The type is quite distinct in coloration, the oval oblique pale spots at the elytral apex being well defined. This maculation probably becomes gradually obsolete, however, in a large series.

56. **A. melancholicus** Laf.—Mon., p. 174; *latebrans* Lec.: Proc. Acad. Nat. Sci., Phila., 1852, p. 101; *spretus* Lec.: l. c.; *facilis* Csy.: Cont. Col. N. A., II, p. 190.

A very small and convex, suboval species, varying in color from black to dark brownish-testaceous, easily recognizable by its small and convex eyes, which are at a great distance from the base, the small prothorax, narrowly suboval elytra, with the humeri only moderately exposed and somewhat rounded at base. Length 1.75–1.85 mm.; width 0.6 mm.

This species, which has been carefully described by LaFerté, is widespread in distribution, the series in my cabinet being from Kansas, Lake Superior, North Carolina and Pennsylvania; it is recorded by LeConte also from Boston, Mass. There can be no doubt whatever of the synonymy proposed above.

57. **A. ictericus** Laf.—Mon., p. 149.

Somewhat narrowly convex, pale ochreo-flavate and moderately shining throughout; pubescence moderately long, subdecumbent, coarse and not dense. Head wider than long, broadly, transversely truncate at base; eyes very small, extremely convex and prominent, the tempora swollen, rounded, much larger than the eyes and fully as prominent; punctures fine, rather close-set; antennæ not as long as the head and prothorax, stouter toward apex, especially the last three joints. Prothorax not quite as wide as the head, wider than long, prominent and subangulate laterally near the apex, the sides thence strongly oblique and feebly sinuate to the base; apex broadly, circularly arcuate; punctures fine, deep and rather dense. Elytra not more than two-thirds longer than wide, very nearly twice as wide as the prothorax, circularly rounded at apex, the humeri moderately exposed at base; sides parallel, feebly but distinctly arcuate; punctures rather fine but strong, close-set. Abdomen shining, punctulate, the legs slender. Length 1.7 mm.; width 0.6 mm.

Florida. The male sexual characters are somewhat feeble; the copulatory sheath is very broadly and circularly rounded at apex, longitudinally impressed along the middle dorsally, and broadly excavated beneath. LaFerté's measurements appear to be care-

fully made, and are a decided aid in identification; otherwise his description of this species is very superficial.

There is another Florida example before me, agreeing nearly with *ictericus*, but having the eyes larger and less convex, the prothorax relatively larger and the elytra more elongate.

58. **A. convexulus** n. sp.—Stout, suboval, convex, moderately shining, pale ochreo-testaceous throughout; pubescence rather abundant, somewhat long, coarse, subdecumbent and conspicuous. *Head* transverse, broadly, rectilinearly truncate at base; eyes moderately large and convex, the tempora slightly swollen, rounded, subequal in length and prominence to the eyes; punctures fine, somewhat sparse, with a narrow smooth line; antennæ one-half longer than the head, feebly incrassate, the last three joints especially stouter. *Prothorax* large, convex, much wider than long, as wide as the head, prominent and obtusely subangulate laterally near the apex, the sides thence strongly oblique and feebly sinuate to the base; apex broadly and circularly rounded; punctures fine but strong, close-set. *Elytra* scarcely more than one-half longer than wide, three-fourths wider than the prothorax, evenly but rather broadly rounded at apex, the humeri somewhat narrowly exposed and rounded at base; sides parallel, evenly and distinctly arcuate; scutellar impression and omoplates completely obsolete. *Abdomen* shining, feebly punctate, the legs rather short, moderately slender. Length 1.9 mm; width 0.7 mm.

South Carolina.

This species is evidently closely allied to *ictericus*, but is somewhat larger and noticeably stouter, with relatively shorter and more oval elytra, larger and broader prothorax, and larger though less prominent eyes.

59. **A. maritimus** Lec.—Ann. Lyc. Nat. Hist., N. Y., V, p. 156; Proc. Acad., Phila., 1852, p. 102.

Stout, convex, suboval, minutely reticulate and dull, pale ochreo-flavate; abdomen picescent; elytra blackish, with the base, suture and apex paler, varying to pale throughout; pubescence short, cinereous, subdecumbent, rather coarse, abundant and distinct. Head subquadrate, wider than long, transversely truncate and medially impressed at base; eyes moderately large but not very prominent, as long as the tempora and equally prominent, the tempora broadly rounded from the eyes into the base; disk finely, densely punctate, with a narrow smooth line; antennæ slender, very feebly incrassate, one-half longer than the head, the tenth joint transverse. Prothorax somewhat wider than the head, rather longer than wide, convex, widest and broadly rounded near apical third, the sides thence moderately oblique

and straight to a feeble ante-basal constriction; punctures fine and rather close-set. Elytra about one-half longer than wide, not quite twice as wide as the prothorax, evenly and not broadly rounded behind, the outline evenly elliptical, without trace of exposed humeri, apparently subconnate, the wings probably rudimentary; disk convex, without trace of scutellar impression or omoplates, finely, moderately closely punctured. Abdomen finely pubescent, alutaceous. Legs moderate in length and decidedly stout. Mesosternum of normal structure. Length 2.3 mm.; width 0.95 mm.

California (San Diego). One of the most aberrant species of *Anthicus*, because of the perfectly oval elytra without trace of humeral angles; it is quite local in habitat.

This is possibly the species erroneously identified by Dr. Horn in his recent catalogue of the Coleoptera of Lower California (Proc. Cal. Acad. Sci., 2, IV, p. 355), as *ictericus* Laf., the *maritimus* Lec. of Horn probably being any one of the larger species with triangular head, here referred to the genus *Amblyderus* of LaFerté. These last bear only a feeble superficial resemblance to the true *maritimus*, and cannot be associated with it systematically. It is almost needless to add that there is no resemblance whatever between *maritimus* and *ictericus*, which latter does not occur near the Pacific coast, and the same remark applies to *A. sturmi* Laf. (*elegans*), which, as far as known, inhabits the austral regions of the Alleghany Mountains only. The *Notoxus monodon*, of Dr. Horn's list, is *constrictus* Csy.\*

#### NOTES.

*Anthicus lecontei* Chmp., from the Pacific coast of Guatemala, is said by the author to occur also in Arizona, but I have not been able to recognize it. From the description and figure it would seem to be most nearly allied to *stellatus* and *saucius*, from the northern parts of the United States.

*A. squamosus* Laf., is said by Mr. Champion to be a Mexican species, and, as the type of *A. lugubris* came from the same source and cannot be identified among our species, it seems best to re-

\* It may be stated further that the *Trichobaris trinotata* Say, of this list (l. c., p. 358), is either *compacta* or *mucorea*—species which are widely different from *trinotata*.

gard it also as Mexican; these two species might therefore be appropriately stricken from our lists.

*A. impressipennis* Laf., is evidently not an *Anthicus*, but will constitute a genus perhaps allied to that including the Mexican *dromedarius*, but the comparatively simple prothorax, impressed inflated elytra and glabrous integuments form a singular combination, which prevents us from assigning it any definite position.

*A. exilis* Laf., is another very peculiar species, which cannot be retained in *Anthicus*, and which is likewise undeterminable in its affinities.

*A. pallidus* Say, remains unknown.

*A. politus* Say, is more probably a xylophilide than an *Anthicus*, but is completely indeterminate and may be a *Tachys* or some chrysomelide.

*A. cæsiusignatus* Boh., is said to be from "Puna" Island, Cal., and differs completely in type from anything known in the United States. Puna Island is off the coast of Ecuador, and it would be perfectly safe to omit this species from our catalogues in the future.

*A. troglodytes* Boh., likewise differs altogether in type from any known North American species and should be omitted; it is said to occur at San Francisco and in "Taiti."

*A. amplicollis* Boh., said to occur at San Francisco, differs completely in type, as in the two preceding cases, and is evidently not North American; it should also be omitted.

*A. nitidus* Boh., seems to be allied to *nitidulus* Lec., but cannot be identified with any of our species, than which it is much smaller (l.  $2\frac{1}{4}$  mm.; w.  $\frac{3}{4}$  mm.); San Francisco. *A. atomarius* Boh., does not appear to differ from *nitidus* (l. 2.0 mm.; w.  $\frac{2}{3}$  mm.); San Francisco. As these two species have a North American habitus, they might be retained in the lists until their identity can be determined.

Mr. Champion very kindly sent me, some years ago, a number of typical representatives of species described or quoted by him in the *Biologia Centrali-Americana*, and upon these it seems desirable to remark as follows:—

*A. asphaltinus*, *punctipennis* and *occidentalis* Chmp., are members of the genus *Lappus*, but constitute one or two distinct groups, because of marked peculiarities in occipital structure.

*A. teapensis* Chmp., belongs to the genus *Sapintus*, and has the character-

istic vestiture, three-jointed antennal club and other structures fully developed.

*A. exiguus* Chmp., seems to lie between the *nanus* and *ictericus* groups of true *Anthicus*, but is altogether distinct from any of our numerous small species.

*A. dromedarius* Laf., will form the type of a distinct and still unnamed genus, allied to *Malporus*, but with a far greater extension of the mesosternum and complete absence of long erect tactile setæ.

*A. spinicollis* Laf., is also the type of a distinct genus, named *Acanthinus* by LaFerté (Mon., p. 136), and characterized by a great lateral extension of the mesosternum and subseriate elytral punctures; the genus extends into southern Texas.

#### **SAPINTUS** n. gen.

While it is true that the species separated from *Anthicus* under this name appear to possess no very radical structural modification, there are so many minor points of divergence, and the species are so evidently homogeneous among themselves, that I have no doubt of the necessity for the division, especially as these differences are accompanied by a marked peculiarity of general habitus.

The body is stouter than in *Anthicus*, with relatively much longer elytra and smaller prothorax; the elytral epipleuræ are wider, the first joint of the hind tarsi is longer, and the corresponding tibial spurs are shorter and much more slender, sometimes apparently almost obsolete. The vestiture is quite different, consisting of two distinct sets of hairs, besides the erect tactile setæ, the longer and more erect hairs arising from the coarse punctures, the shorter and generally more decumbent pubescence from minute punctules scattered over the interspaces. Finally, the antennæ terminate invariably in an abrupt, though feeble, three-jointed club. In fact *Sapintus* appears to constitute a true genus, and can in no wise be regarded as a subgenus of *Anthicus*; it is confined geographically to the United States east of the Rocky Mountains, extending well into Mexico, and is represented in the arid Sonoran province by one peculiar species; it does not occur at all in the true Pacific coast fauna.

The species can be distinguished among themselves as follows:

Eyes large and rather strongly convex, the body usually stouter.

Body black or brownish-black.

Legs blackish.

Head more strongly and closely punctate, densely and coarsely pubescent; short hairs of the elytra very coarse, pale in color and conspicuous .....1. **pubescens**

Head very feebly and sparsely punctate, sparsely and finely pubescent; short hairs of the elytra fine and darker in color...2. **rusticus**

Legs fulvous; body smaller and narrower.....3. **fulvipes**

Body pale in color.

Pronotum less minutely and very densely punctate, dull.

Elytra larger and much broader, always very much more than twice as wide as the prothorax.

Elytra longer, castaneous, the longer pubescence fine and inclined, not hispid; punctures moderately coarse.....4. **colonus**

Elytra pale testaceous, the suture sometimes feebly blackish; longer pubescence coarse, suberect and hispid.....5. **hispidulus**

Elytra much narrower, scarcely visibly more than twice as wide as the prothorax, pale testaceous, with the suture blackish; pubescence not hispid .....6. **pusillus**

Pronotum extremely minutely and sparsely punctate, polished; erect hairs of the elytra unusually long and bristling; body very stout and convex .....7. **corticalis**

Eyes small, very convex and prominent; body less stout, pale in coloration.

Head broadly arcuato-truncate at base; anterior and intermediate tibiae bent in the male.

Pronotum feebly and narrowly margined at base; elytra strongly impressed at each side of the suture near apical fourth in the male.

8. **festinans**

Pronotum broadly and strongly margined at base; elytra not at all subapically impressed in the male.....9. **mollis**

Head rectilinearly truncate at base, the tibiae not modified in the male; vestiture short, very coarse and recurved.....10. **timidus**

The species may prove to be numerous, especially in the States bordering the Gulf of Mexico.

1. **S. pubescens** Laf.—Mon., p. 177; Lec.: Proc. Acad., Phila., 1852, p. 102 (Anthicus).

Stout, prothorax dull, head and elytra shining, black, the elytra with a slightly brownish tinge; legs black, the coxæ and tarsi paler; abdomen dark rufo-piceous; antennæ pale toward base; pubescence short, dense and coarse on the anterior parts, the erect hairs of the elytra rather long, dark and fine, the shorter pubescence coarse, pale and conspicuous. Head convex, finely punctate, truncate at base, the eyes large and convex. Prothorax wider than long, slightly narrower than the head, convex, densely punctate, widest and narrowly rounded between apical third and



fourth, the sides thence strongly oblique and nearly straight for a short distance to the basal margin, which is tumid at the sides, becoming gradually narrower to the middle of the dorsal surface; collar short, not constricted, but separated from the pronotum by a fine deep line. Elytra very large, three-fourths longer than wide, fully two and one-half times as wide as the prothorax, parallel and feebly arcuate at the sides, the apex circularly rounded; humeri very widely exposed at base; post-scutellar impression distinct, the omoplates feeble; punctures very coarse and deep, well separated, becoming finer toward apex. Abdomen densely pubescent. Legs moderately short, somewhat stout, the femora not in the least clavate. Length 2.6–2.9 mm.; width 0.95–1.15 mm.

Rhode Island, New York and Iowa (Iowa City and Independence). The paler coloration assigned by LaFerté is probably due to immaturity, as this is without much doubt the species described by that author, and is one of the largest of the genus. The male sexual characters are pronounced, the anterior coxæ being posteriorly spinose, the anterior tibiae slightly bent inward toward apex and densely clothed with short stiff hairs, the fifth ventral with a short, broadly rounded and abruptly porrect lobe at apex which is finely and transversely impressed at its base, the genital segment coriaceous and broadly sinuate, and the copulatory spicule short, slender, with an elongate and feebly dilated, evenly and acutely lanceolate tip.

2. **S. rusticus** n. sp.—Moderately stout and convex, shining, the pronotum dull, black; abdomen not paler; legs and antennæ towards base slightly picescent; pubescence short and fine, abundant but rather dark in color, the longer hairs of the elytra inclined and not very conspicuous. *Head* convex, much wider than long, truncate and very feebly, medially impressed at base; temporal angles broadly rounded to the eyes, the latter rather large and somewhat prominent, very coarsely faceted as usual; antennæ not quite as long as the head and prothorax, somewhat slender, the joints obconical, bristling as usual with long erect setæ in addition to the short pubescence, club feeble, the ninth joint much longer than wide and longer than the tenth which is not wider than long and obconical, eleventh rather short, only slightly longer than the tenth, pointed. *Prothorax* quite distinctly narrower than the head, almost as long as wide, convex, parallel and rounded at the sides in apical half, then convergent and sinuate to the base which is broad and margined; collar short and very broad, not constricted; punctures moderately fine, strong and very dense throughout. *Elytra* long, fully four-fifths longer than wide, but little more than twice as wide as the prothorax, parallel and arcuate at the sides, becoming straight in basal fifth; apex circularly and not very broadly rounded; humeri

broadly exposed and rounded to the prothorax; post-scutellar impression distinct, the intra-humeral subobsolete; omoplates large and very feeble; punctures sparse and only moderately coarse. *Abdomen* dull, very densely clothed with short fine and dark pubescence. *Legs* moderately long and somewhat stout. Length 2.75 mm.; width 0.9–1.0 mm.

Iowa (Keokuk).

The description is taken from the male, which has very feeble sexual characters in striking contrast to the preceding species. The anterior legs and trochanters are normal, the fifth ventral much longer than the fourth, unmodified on the disk, the apex feebly truncate and with a finely but strongly beaded edge, the genital segment dark and subcorneous, perfectly even on the disk, with the apex broadly and evenly truncate. The female differs from the male considerably in general form, the prothorax being smaller, shorter and more narrowly rounded at the sides anteriorly, the elytra relatively much broader, more strongly arcuate at the sides and nearly two and one-half times as wide as the prothorax. The single pair represents a species allied in general characters to *pubescens*.

3. **S. fulvipes** Laf.—Mon., p. 177; Lec.: Proc. Acad., Phila., 1852, p. 102 (Anthicus).

Moderately stout, convex, polished, the pronotum dull, black to brownish-black, the head, prothorax and under surface frequently dark piceo-rufous; antennæ and legs throughout pale rufo-testaceous; apices of the abdominal segments clouded with blackish; pubescence rather short, abundant, pale and conspicuous, the longer hairs of the elytra inclined and not very noticeable. Head transverse, very minutely and sparsely punctate, the eyes large and prominent. Prothorax much narrower than the head, not quite as long as wide, strongly rounded at the sides anteriorly, narrowed and sinuate thence to the base, which is distinctly margined; disk finely but strongly, very densely punctate. Elytra barely three-fourths longer than wide, distinctly more than twice as wide as the prothorax, wider behind the middle than at base, the sides arcuate; punctures sparse and coarse. Abdomen pubescent; metasternum almost impunctate. Length 2.25–2.5 mm.; width 0.8–0.9 mm.

Texas and Louisiana,—Cab. LeConte. I obtained a good series of this species at Galveston. The male, from which the above outline is drawn, has the anterior trochanters and tibiæ unmodi-

fied, the fifth ventral broadly rounded or subtruncate and even at apex, with the edge finely beaded, the genital segment feebly sinuato-truncate, the copulatory sheath long, flat, gradually tapering to an acute point, moderately arcuate downward to near the apex, then feebly turned upward in a slight sigmoid curve, the efferent duct slender, much shorter than the superior corneous spicule, flattened and lanceolate at apex, and apparently with the opening on its upper surface.

4. **S. colonus** n. sp.—Rather stout and convex, shining, the pronotum duller, pale castaneous, the head, prothorax and antennæ paler and more rufous, the latter slightly infusate at apex; entire under surface and legs pale flavo-testaceous; pubescence somewhat short and abundant, the longer hairs of the elytra inclined and only moderately distinct. *Head* transverse, convex, truncate but scarcely at all impressed at base, the temporal angles broadly rounded to the eyes, which are large and prominent; punctures minute and sparse; antennæ short, slender, the club thick, rather compact and darker. *Prothorax* much narrower than the head, not quite as long as wide, somewhat broadly rounded at the sides in apical half, deeply sinuate thence to the expanded and strongly margined base, which is about as wide as the disk; punctures fine but strong, unequal in size and only moderately densely crowded. *Elytra* fully three-fourths longer than wide, much more than twice as wide as the prothorax, parallel and much rounded at the sides except toward base, the apex rather narrowly and subparabolically rounded; humeri moderately exposed and rounded to the prothorax; disk strongly impressed behind the scutellum, the omoplates feeble; punctures moderately coarse and sparse. *Abdomen* minutely, densely punctate, the interspaces polished; pubescence dense but fine and not very conspicuous. *Legs* short, the femora moderately stout. Length 2.5 mm.; width 0.9 mm.

#### Delaware.

The single specimen before me is of undeterminable sex; the fifth ventral has a rounded and very shallow, sparsely punctate median area, but the segment is short, only slightly longer than the fourth, and there are no other essentially male characters, although there seems to be a coriaceous genital segment visible by glancing under the tip of the fifth. This species is allied to *fulvipes*, but differs in its paler color, larger size, closer and less coarse elytral punctuation and denser vestiture; the elytra are a little longer.

5. **S. hispidulus** n. sp.—Stout, convex, shining, the pronotum dull, pale rufo-testaceous throughout, the antennal club and elytral suture frequently infusate; pubescence rather long and erect, abundant, pale, bristling and

conspicuous on the elytra. *Head* transverse, convex, broadly, feebly arcuato-truncate at base but not impressed; temporal angles broadly rounded to the eyes, which are large and very prominent; punctures fine and feeble, sparse; antennæ about as long as the head and prothorax, slender, the club moderately thick. *Prothorax* small, scarcely three-fourths as wide as the head, not quite as long as wide, narrowly rounded at the sides anteriorly, thence parallel and distinctly sinuate to the basal margin, which is distinct and as wide as the disk; collar short, parallel, moderate in width; disk convex, strongly and densely punctate, the punctures polygonally crowded. *Elytra* two-thirds longer than wide, fully two and one-half times as wide as the prothorax, parallel and feebly arcuate at the sides, the apex broadly and semi-circularly rounded; humeri rather broadly exposed and rounded to the prothorax; post-scutellar impression broad and feeble, the omoplates almost obsolete; punctures coarse, deep and sparse. *Abdomen* minutely and somewhat sparsely punctate, polished, clothed with rather long and coarse pubescence. *Legs* rather short and stout. Length 2.25–2.5 mm., width 0.8–0.9 mm.

Texas (Austin).

The description is drawn from the female, but the male scarcely differs in general form, except that the elytra are less dilated behind.

The male has the anterior and intermediate trochanters acutely angulate and prominent posteriorly, but scarcely spinose, the corresponding tibiæ unmodified, the fifth ventral short, scarcely visibly longer than the fourth, broadly rounded or subtruncate, with a finely beaded edge at apex but unmodified on the disk, the genital segment subcorneous, flat, smooth, transversely and widely truncate at apex, the edge provided with a few widely spaced short stiff setæ, the copulatory sheath moderate in length, flat, straight in profile, the sides subparallel or just visibly convergent and straight from the base nearly to the apex, where it is abruptly narrowed and produced in a slender acute point; on the upper surface it is obtusely and strongly carinate along the median line, the carina continuing along the narrowed apical spicule to the extreme apex; the efferent duct is shorter than the upper and penetrative organ, and both together project from a short basal sheath in the nature of a second genital or pseudo-segment. Four specimens.

6. **S. pusillus** Laf.—Mon., p. 178 (Anthicus).

Rather narrow, convex, shining, the pronotum and abdomen dull, pale rufo-testaceous, the antennal club and elytral suture blackish; pubescence pale, short and moderately dense, coarse,

the longer hairs of the elytra inclined but coarse and distinct. Head finely but rather closely punctate, the eyes large and convex. Prothorax narrower than the head, of the usual form but with the base distinctly narrower than the maximum width, the punctures of different sizes, rounded, dense but not polygonally crowded. Elytra three-fourths longer than wide, only very slightly more than twice as wide as the prothorax, parallel and slightly rounded at the sides, evenly and not very broadly rounded at apex; humeri not very widely rounded to the prothorax; omoplates feeble; punctures moderately coarse and sparse. Abdomen finely and densely punctate. Legs somewhat short and stout. Length 2.2 mm.; width 0.75 mm.

Florida and Louisiana (New Orleans,—LaFerté). The single specimen in my cabinet seems to be a male, judging by the exposed pygidium; it has the anterior coxæ angulate behind and the corresponding tibiæ not bent but densely clothed with short stiff setæ within toward apex, the intermediate trochanters and tibiæ not modified, the fifth ventral long, evenly and almost semi-circularly rounded, unmodified on the disk and about three-fourths longer than the fourth. This form of the fifth segment is very different from that of *hispidulus*, and in fact throughout the present genus the species, which generally resemble each other very strongly or adhere to a common type of structure, differ strikingly among themselves in the secondary sexual modifications of the male.

There are several points in the original description of *pusillus*, which give rise to grave doubts concerning the identity of the present species. For example, the phrase "les yeux très-peu saillants," will not accord with this form, nor with any other of the genus known to me; also "corselet....rétréci faiblement et progressivement depuis les pommettes, qui sont peu saillantes, jusque'à la base, qui ne paraît nullement marginée;" finally "elytres....presque trois fois aussi larges que le corselet et plus de deux fois aussi longues que larges....en oval très-allongé postérieurement." The length and width are given as 2.0 and 0.6 mm., respectively; that is, if these measures are correct, the insect is proportionally much more slender than any other of this part of the genus, and yet the elytra are nearly three times as wide as the prothorax. Either the description is grossly inexact, or the insect of LaFerté is a very remarkable species, quite dif-

ferent from any known to me.\* My only reason for adhering provisionally to the present identification, is that my single representative is a male; in the female the prothorax is sometimes proportionally distinctly smaller than in the male.

7. **S. corticalis** Lec.—Ann. Lyc. Nat. Hist., N. Y., V, p. 154; Proc. Acad., Phila., 1852, p. 102 (Anthicus).

Very stout, convex, polished throughout, dark brown in color; legs and antennæ paler, the latter infusate at apex; pubescence fine and not very dense, the longer hairs of the elytra unusually long, suberect and bristling. Head transverse, convex, truncate, unimpressed, minutely and sparsely punctulate, the eyes large and prominent; antennæ a little longer than the head and prothorax, rather thick at apex. Prothorax distinctly narrower than the head, almost as long as wide, minutely and remotely punctate; sides prominent and rounded anteriorly, sinuate in basal two-thirds, the base margined and almost as wide as the disk. Elytra stout, two-thirds to scarcely more than one-half longer than wide, distinctly more than twice as wide as the prothorax in the male, two and one-half times in the female, very obtusely but evenly rounded at apex, coarsely and sparsely but somewhat feebly punctate. Length 2.25–2.8 mm.; width 0.8–1.15 mm.

California (Yuma). This species is quite distinct from any other in its highly polished, very minutely and remotely punctate pronotum and obese form. The male has the anterior trochanters prolonged behind in a very long spiniform process, the intermediate in a shorter and more lamelliform process, with both the corresponding tibiæ bent inwardly toward apex. The fifth ventral unmodified, moderate in length and parabolically rounded behind throughout, the copulatory sheath slender, gradually tapering to a fine point, flat, not modified dorsally, excavated beneath and slightly turned upward near its middle when viewed in profile. I obtained three specimens at the locality indicated.

8. **S. festinans** n.sp.—Moderately stout, convex, shining, the head and pronotum alutaceous, pale brownish-testaceous, the elytral suture and antennal apex slightly infusate; pubescence pale and coarse, not very dense, moderate in length, the longer hairs of the elytra coarse and inclined. Head transverse, convex, finely and feebly but densely punctate, except toward base,

\* It seems probable that in the case of this species and *fulvipes*, the author has mistaken the subbasal marginal line for the true base of the prothorax.

where the sculpture becomes obsolete; base broadly arcuato-truncate, the angles rounded, the tempora long, becoming straight and parallel to the eyes, which are small, very convex and prominent; antennæ about as long as the head and prothorax, slender, the three outer joints thicker. *Prothorax* convex, quite distinctly narrower than the head, not quite as long as wide, rather broadly rounded at apical third, the sides thence convergent and feebly sinuate to the base, which is narrowly margined and much narrower than the disk; punctures fine and very dense. *Elytra* three-fourths longer than wide, but slightly more than twice as wide as the prothorax; sides parallel and arcuate; apex obtusely rounded; humeri moderately exposed at base, rounded; scutellar impression obsolete, the omoplates very feeble; punctures somewhat coarse and sparse. *Abdomen* alutaceous, finely, densely punctate, pubescent, blackish with the apex pale. *Legs* slender, the femora somewhat stout. Length 2.0–2.5 mm.; width 0.65–0.8 mm.

Colorado (Greeley); Iowa.

The four specimens before me vary greatly in size as is usual in this genus, and the description is drawn from the male, this sex having the anterior tibiæ very strongly arcuate and pubescent within, the intermediate more apically and less strongly arcuate, the anterior trochanters feebly and obtusely prominent behind, the intermediate unmodified, the fifth ventral moderate in length and evenly rounded behind, unmodified or only slightly flattened on the disk. The female has the prothorax smaller, and the elytra shorter and relatively broader, and, in one specimen, completely infusate except toward the humeri and sides before the middle.

9. ***S. mollis*** n. sp.—Slightly stout, convex, pale brownish-testaceous throughout, the antennæ blackish at apex, the elytral suture not darker, shining, the head, pronotum and abdomen alutaceous; pubescence not dense, rather short and coarse, the coarser hairs of the elytra inclined. *Head* slightly transverse, finely, very densely punctate, with a narrow impunctate line except toward base, where the punctures become feeble; basal angles somewhat narrowly rounded; tempora long, parallel and feebly arcuate; eyes small, very convex and prominent; antennæ rather longer than the head and prothorax, slender, the club abrupt and distinct. *Prothorax* small, much narrower than the head, not quite as long as wide, evenly and circularly rounded anteriorly, the sides thence convergent and sinuate to the base which is very widely and strongly margined, slightly dilated at the sides and distinctly narrower than the disk; surface finely, densely punctate. *Elytra* three-fourths longer than wide, distinctly more than twice as wide as the prothorax, parallel and broadly arcuate at the sides, evenly and not very broadly rounded at apex; humeri obtuse and moderately exposed; post-scutellar impression distinct at each side of the suture; omoplates large, very feeble; punctures moderately coarse and sparse. *Abdomen* minutely and densely punctured, the legs rather short and stout. Length 2.2 mm.; width 0.75 mm.

## Michigan.

This species, which is represented by a single male, is closely allied to *festinans*, but differs in its smaller prothorax which is much more broadly margined at base, in its feebler and closer elytral punctures and in the sexual characters. The anterior and intermediate femora are distinctly arcuate toward apex, but the trochanters are unmodified, the fifth ventral moderate in length, rounded or feebly subtruncate at apex and unmodified on the disk. The elytra completely lack the strong and conspicuous subapical impressions near the suture which characterize the male of *festinans*.

10. **S. timidus** n. sp.—Slightly stout, convex, shining and rufo-testaceous throughout; pubescence of the head and pronotum very short, stiff, strongly arcuate and not dense, intermingled on the latter with some long tactile setae, on the elytra short, stiff and strongly arcuate, longer, straight and finer near the suture, the short hairs extremely minute but very coarse, the vestiture not dense and pale throughout. *Head* transverse, convex, not distinctly punctate, rectilinearly truncate and unimpressed at base, the angles broadly rounded, the tempora becoming parallel just behind the eyes which are rather small, convex and prominent, situated at much more than their own length from the base; antennae somewhat longer than the head and prothorax, slender, the three outer joints broader but not in the least darker in color. *Prothorax* rather large, convex, only slightly narrower than the head, not quite as long as wide, broadly rounded and widest just before the middle, the sides becoming strongly convergent and feebly sinuate toward base, the latter strongly margined and not more than three-fourths as wide as the disk; punctures fine and well separated, dense in the middle toward base. *Elytra* scarcely more than two-thirds longer than wide, not distinctly more than twice as wide as the prothorax, the sides parallel and very feebly arcuate, rather narrowly rounded behind in apical third; humeri rounded, widely exposed at base; scutellar impression and omoplates obsolete; punctures rather small but deep, only moderately sparse. *Abdomen* somewhat shining, obsoletely punctulate. *Legs* moderate in length, somewhat slender. Length 2.1 mm.; width 0.7 mm.

## Florida.

The single male represents a species widely different from any other here described in its peculiar vestiture and subglobular prothorax. The legs and trochanters are not perceptibly modified, but the fifth ventral has a peculiar discal excavation; the posterior edge of the segment is quite evenly rounded, but thick and deep vertically, and the large rounded impunctate pit at the middle of the disk thins out the vertical posterior edge into a flat



translucent plate. The genital segment is moderate in size, smooth, polished, even and pale in color, with the apex transversely truncate. The other organs are not visible in the type.

### AMBLYDERUS Laf.

The American species referred to this genus apparently differ in no essential particular from the North African types of La-Ferté, the tubercles along the crest of the subapical declivity of the pronotum being however always inconspicuous. *Amblyderus* is without doubt a perfectly valid genus, and will prove to be a tolerably large one in the colder parts of the eastern United States and in the true Pacific coast faunal region, where its members constitute one of the most characteristic elements of the sea-beach population.

The eight species here deemed worthy of description may be recognized as follows:—

Species of the Pacific Coast; elongate-oval, very convex, densely clothed with short coarse decumbent pubescence; tubercles and punctures of the pronotum indiscriminately intermingled and apparently mutually independent.

Larger species, not under 3 mm. in length.

Elytra black, rarely dark brown, the head and prothorax paler..1. **obesus**

Elytra and entire body pale luteous-white, the integuments translucent; elytra shorter and more attenuate near the apex.....2. **albicans**

Smaller species, always distinctly less than 3 mm. in length.

Stouter, the head very small, scarcely more than two-thirds as wide as the prothorax.....3. **parviceps**

Rather slender, the head relatively larger, about five-sixths as wide as the prothorax.....4. **gracilentus**

Species of the Great Lakes and Atlantic Coast; tubercles of the pronotum situated each immediately before a setigerous puncture, the punctures and tubercles evidently mutually connected.

Antennæ shorter, stouter and submoniliform except toward base; vestiture rather sparse and somewhat readily removable.

Elytral punctures rather small, sparse and not very strong but abruptly defined .....5. **granularis**

Elytral punctures coarse, much closer and impressed; elytra shorter; prothorax much more transverse.....6. **punctiger**

Antennæ long and slender, gradually and more or less feebly stouter toward apex; vestiture finer and closer; body more oval and convex, the integuments pale.

Elytra two-thirds longer than wide. Lake Superior.....7. **pallens**

Elytra much shorter and more opaque, scarcely one-half longer than wide. Atlantic Coast.....8. **arenarius**

*Obesus*, *granularis* and *pallens* are typical of three distinct sections of the genus, and the old world species will add several others.

1. **A. obesus** n. sp.—Stout, very convex, dull, the elytra alutaceous, rufo-testaceous, the elytra, metasternum and abdomen black, varying to brown; pubescence short, coarse, cinereous, recumbent, rather dense and conspicuous, devoid of erect setæ. *Head* triangular, slightly wider than long, rather depressed, the base transversely truncate or even very feebly sinuato-truncate but not distinctly impressed; tempora narrowly rounded, very prominent; eyes large, convex, at about three-fourths of their own length from the base; disk finely and closely tuberculose, with a wide smooth median line toward apex; antennæ scarcely one-half longer than the head, somewhat slender, moderately incrassate, the tenth joint slightly wider than long, eleventh only slightly longer than the tenth, rounded, obtusely pointed. *Prothorax* transversely trapezoidal, distinctly wider than the head, widest and more strongly rounded near the apex, the sides thence convergent and broadly, evenly arcuate to the basal margin which is distinct and cylindrical for a short distance to the base; apex transversely and very feebly arcuate, nearly one-half wider than the base; disk finely, closely tuberculose, also minutely punctate, abruptly declivous and very feebly concave toward the middle anteriorly, the summit of the declivity not more strongly tuberculose; median line slightly impressed. *Elytra* suboval, very convex, scarcely more than one-half longer than wide, a little more than one-third wider than the prothorax, the sides subparallel, evenly and strongly arcuate; apex somewhat narrowly subtruncate; sides toward base evenly rounded almost to the prothorax, the base broadly sinuate, the basal parts of the humeri very narrow and strongly rounded; disk finely, closely punctate, without impressions or omoplates. *Abdomen* dull, strongly reticulate, finely but strongly, densely punctate. *Legs* as in *Anthicus*, moderately long, thick. Length 3.1–3.8 mm.; width 1.25–1.4 mm.

California (San Francisco).

The male has the anterior tibiæ thick and strongly, inwardly arcuate toward apex, the fifth ventral rounded behind and unmodified, the genital segment large, corneous, black, truncate at apex and transversely, unequally impressed throughout the width; the copulatory spicule is broad and stout, but rather abruptly narrowed near the apex and prolonged in a slender straight process which is very strongly compressed and vertically laminiform, the apex slightly swollen vertically and obtuse in profile.

This is one of the largest, and, with the exception of *Tanarthrus salinus*, probably the bulkiest species of the tribe in North America. I have taken it in large numbers on the sandy sea-beaches near the city.

2. **A. albicans** n. sp.—Stout and convex, alutaceous, pale luteous-white to pale brownish throughout; pubescence rather dense, moderately long and coarse, decumbent, cinereous and even. *Head* triangular, as long as wide, truncate and broadly, medially impressed at base, the tempora very prominent and narrowly rounded; eyes moderately large, at less than their own length from the base; disk shining but covered somewhat closely with a mixture of small punctures and minute tubercles, which become very feeble anteriorly; smooth median line gradually narrower posteriorly, scarcely extending to the base; antennæ scarcely one-half longer than the head, slender, feebly incrassate, the penultimate joint rather wider than long. *Prothorax* transversely trapezoidal, widest and more narrowly rounded near the apex, distinctly wider than the head and throughout nearly as in *obesus*, except that the punctures are fine and strong and the intermingled tubercles generally smaller and sparser. *Elytra* not quite one-half longer than wide, nearly one-half wider than the prothorax, oval, slightly attenuate behind, the apex not very broadly subtruncate; sides strongly arcuate, more rounded at the humeri, the latter very narrowly exposed at base; punctures rather fine but strong and close-set. *Abdomen* finely but strongly punctate, the punctures distinctly separated; pubescence coarse, the legs stout. Length 3.0–3.2 mm.; width 1.25 mm.

California (sea-beaches of Los Angeles Co.). Mr. Wickham.

The male has sexual characters of the same type as in *obesus*, except that the genital segment is pale in color and more coriaceous; the copulatory sheath is not protruded in any of the types.

This species is allied to *obesus*, but differs in its more feeble sculpture of the head and pronotum, in its shorter and more rounded elytra, smaller size, and very pale coloration, the integuments being diaphanous. In both this and the preceding species the elytra have each a short canaliculation along the suture near posterior third, which is common to both sexes. Four specimens.

A female before me seems to represent a distinct species allied to the above; it is entirely pale, with the sutural bead blackish and the elytra longer, with the punctures larger, stronger and more impressed. This specimen has a deep fovea-like impression behind the left hind coxa, of which there is no trace on the right side, but is not deformed in any other way.

3. **A. parviceps** n. sp.—Moderately stout, very convex, feebly shining, dark rufo-testaceous, the under parts of the hind body and the elytra in great part suffused with blackish; pubescence moderate in length, coarse, somewhat dense, recumbent, cinereous and distinct, without trace of erect setæ. *Head* very small, triangular, about as long as wide, feebly convex, closely covered with fine punctures and small tubercles, the smooth median line wide anteriorly, becoming narrow toward base but entire; eyes moderately large and

convex, at scarcely more than their own length from the base; tempora very prominent, rounded; base transverse, the subvertical basal wall feebly impressed toward the middle; antennæ nearly as long as the head and prothorax, moderately incrassate. *Prothorax* transversely trapezoidal, at least one-third wider than the head; sides convergent and arcuate from near the apex to the basal margin; apex transverse, feebly arcuate, nearly one-half wider than the base; surface closely covered with small punctures and tubercles, the median line impressed toward apex. *Elytra* elongate-oval, two-thirds longer than wide, two-fifths wider than the prothorax; sides evenly arcuate; base broadly sinuate, the apex equally broadly subtruncate; humeri narrowly exposed at base; disk evenly convex, finely, not very closely punctate, without further modification, except the subsutural impressions at apical third which are feeble. *Abdomen* dull, densely reticulate, finely punctate, rather sparsely and coarsely pubescent. *Legs* somewhat long and not noticeably stout. Length 2.6–2.8 mm.; width 1.0 mm.

California (southern). Mr. H. C. Fall.

The apical declivous surface of the pronotum is distinctly and transversely concave, but its upper crest is not more strongly tuberculose. The male has the anterior tibiæ bent, the fifth ventral feebly sinuato-truncate at apex but otherwise unmodified, the genital segment moderate in size, pale, truncate, and transversely and unequally impressed, the copulatory spicule with the tip abruptly narrowed and produced in a short slender acute point, which is subcylindrical and not noticeably compressed.

With the two males which I received from Mr. Fall, I have associated a single male from Alameda Co., which does not seem to differ specifically.

4. **A. gracilentus** n. sp.—Rather narrow but strongly convex, somewhat shining, pale rufo-testaceous, except the abdomen and elytra, which are slaty-black; pubescence recumbent, coarse and dense as usual. *Head* triangular, rather longer than wide, feebly convex, coarsely and not densely tuberculose, with some intermingled and very minute punctures, the smooth median line entire, very wide anteriorly; eyes rather large, moderately prominent, situated at scarcely three-fourths of their length from the base; tempora obtusely angulate, but only slightly more prominent than the eyes; base transversely truncate, feebly concave toward the middle of the basal wall; antennæ somewhat slender, feebly incrassate, two-thirds longer than the head. *Prothorax* rather small, moderately convex, only slightly wider than long, distinctly wider than the head, the sides convergent and strongly arcuate from near the apex to the basal margin, thence parallel for a short distance to the base; apex transversely arcuate; disk strongly tuberculose and with fine punctures, the median line feebly impressed, more strongly so toward apex, the apical declivity pronounced and with the tubercles along its crest slightly stronger. *Elytra* suboval, evenly convex, scarcely more than one-half longer

than wide, fully two-thirds wider than the prothorax, rather attenuate behind; base broadly sinuate, the apex much more narrowly subtruncate; sides evenly arcuate; humeri distinctly exposed at base; punctures fine and dense. *Abdomen* alutaceous, minutely punctate, finely pubescent. *Legs* moderate in length, somewhat stout. Length 2.4 mm.; width 0.8 mm.

California (near San Francisco).

The narrower form, still smaller size and relatively larger head will readily distinguish this species from the preceding. In the male the anterior tibiae are bent toward apex, the fifth ventral feebly sinuato-truncate at apex but not otherwise modified, the genital segment thin, broad, truncate at apex, strongly and transversely impressed, the surface bent downward toward apex throughout; the copulatory spicule is abruptly narrowed near the apex and produced in a short slender process, which is gradually bent upward and not compressed; the efferent duct beneath the spicule is broad, flat, transversely truncate at tip, bent first downward then upward and projects in the type specimen far beyond the corneous spicule.

5. **A. granularis** Lec.—Agass. "Lake Superior," p. 231; Proc. Acad., Phila., 1852, p. 103 (*Anthicus*).

Elongate, subparallel, moderately stout and convex, shining, dark rufo-testaceous, the under surface of the hind body black; elytra paler and more flavate, with a broad median black fascia which sometimes covers almost the entire disk; pubescence coarse and decumbent but rather short and sparse. Head triangular, wider than long, truncate, coarsely and not densely tuberculose, the fine punctures each near a tubercle; median smooth line narrow and irregular; eyes moderately large; antennae slender, the outer joints submoniliform, three-fourths longer than the head. Prothorax transversely trapezoidal, just visibly wider than the head, the sides convergent and feebly arcuate from near the transversely arcuate apex to the basal margin, thence parallel to the base; disk broadly impressed along the median line, coarsely tuberculate, the fine punctures each near the posterior extremity of a tubercle. Elytra oblong, two-thirds longer than wide, one-half wider than the prothorax, semi-circularly rounded behind, parallel and feebly arcuate at the sides; humeri widely exposed at base; disk with a feeble intra-humeral and more distinct post-scutellar impression, the omoplates slightly visible; punctures small and rather sparse. Abdomen shining, finely sparsely and

unevenly punctate. Legs rather long and slender. Length 3.0 mm.; width 1.1 mm.

Lake Superior,—Cab. LeConte. The male has the anterior tibiae feebly bent but not much thickened; the female scarcely differs in form.

6. **A. punctiger** n. sp.—Stout and convex, shining, pale rufo-testaceous, the under surface of the hind body only slightly picescent; elytra more flavate, each with a small feebly defined median spot of piceous tint; pubescence very short, coarse, decumbent, cinereous and rather sparse, the prosternum and under surface of the head with a few very long erect setae. *Head* triangular, wider than long, shining but coarsely, sparsely tuberculose and minutely punctate, the smooth median line nearly even, distinct and entire; base truncate; tempora very prominent and angulate; eyes rather large, at much less than their own length from the base; antennae rather short, about one-half longer than the head, moderately stout, submoniliform except toward the base, the tenth joint transverse, eleventh at least one-half longer than the tenth, conoidal. *Prothorax* short and strongly transverse, just visibly wider than the head, the sides parallel and evenly, subcircularly rounded to just before the middle, then becoming very strongly convergent to the basal margin at basal sixth or seventh, then parallel to the base; apex transversely evenly and feebly arcuate; disk coarsely, rather closely tuberculose, impressed along the median line except toward base. *Elytra* oblong-oval, scarcely more than one-half longer than wide, the sides evenly and distinctly arcuate; base sinuate for the thoracic base; the apex not very broadly, obtusely rounded; humeri widely exposed at base; disk with the basal impressions and omoplates subobsolete, the punctures coarse, widely impressed, deep and moderately separated. *Abdomen* finely and somewhat irregularly punctate. *Legs* moderately long and slender, the femora distinctly, subasperately punctate. Length 2.9 mm.; width 1.1 mm.

Lake Superior.

The single female before me represents a species rather closely allied to *granularis*, but differing conspicuously in the more broadly rounded sides of the prothorax anteriorly, in its shorter, more oval and rounded, more posteriorly attenuate and much more coarsely and closely punctate elytra, somewhat shorter antennae, coloration and in a number of other characters.

7. **A. pallens** Lec.—Agass. "Lake Superior," p. 231; Proc. Acad., Phila., 1852, p. 103 (Anthicus).

Stout and convex, rather dull, pale flavo-testaceous throughout; pubescence short, coarse, decumbent and not very dense. Head triangular, fully as long as wide, finely, sparsely tuberculose, with an even and entire smooth median line; base truncate, dis-

tinctly impressed in the middle; tempora prominent; eyes somewhat large, at much less than their own length from the base; antennæ very slender, just visibly incrassate, almost as long as the head and prothorax, the tenth joint longer than wide. Prothorax scarcely visibly wider than the head, trapezoidal, minutely, sparsely tuberculose, widest at apical fourth. Elytra convex, oval, two-thirds longer than wide, one-half wider than the prothorax, the sides evenly arcuate; humeri somewhat widely exposed at base; disk finely and not densely punctate, the basal impressions and omoplates extremely feeble. Legs moderately long and slender. Length 2.6–2.8 mm.; width 0.95 mm.

Lake Superior,—Cab. LeConte; Wisconsin (Bayfield),—Mr. Wickham. The anterior tibiæ of the male bristle within with stiff erect setæ; they are swollen within toward the middle and slightly bent toward apex; the fifth ventral is feebly subtruncate at apex, the genital segment truncate, with the surface deeply and transversely impressed.

8. **A. arenarius** n. sp.—Stout, convex, pale luteous throughout, except the abdomen, which is clouded with blackish; head and pronotum slightly shining, finely reticulate, the elytra dull and strongly, more granularly reticulate; pubescence short, coarse, decumbent and rather dense. *Head* triangular, as long as wide, truncate and medially impressed at base, the tempora not very angulate, rounded; eyes large, convex, at much less than their own length from the base and not much less prominent than the tempora; surface rather finely, sparsely tuberculose, with an entire median impunctate line; antennæ long, slender, distinctly incrassate and slightly infusate toward apex, two-thirds longer than the head, the tenth joint not quite as long as wide. *Prothorax* just visibly wider than the head and but slightly transverse, widest very near the apex, the sides thence just visibly convergent and slightly arcuate to the middle, there becoming more rounded and strongly convergent to basal sixth, thence parallel to the base; apex transversely, evenly arcuate; disk finely, not densely granulato-tuberculate. *Elytra* short, oval, convex, one-half longer than wide, two-thirds wider than the prothorax, somewhat attenuate behind and not very broadly obtuse at apex; sides rather strongly arcuate; humeri moderately exposed at base; disk finely but strongly, densely punctate, without impressions or omoplates. *Abdomen* feebly shining, minutely, densely punctate, the legs moderate in length and thickness. Length 2.8 mm.; width 1.0 mm.

Rhode Island (Newport).

The male has the anterior tibiæ swollen within toward the middle and slightly bent toward apex, the fifth ventral evenly rounded and unmodified, the genital segment truncate and deeply, trans-

versely impressed. The single male, which I took immediately behind the ocean beach, represents a species which is closely allied to *pallens*, but differing in its shorter, more opaque and more densely punctate elytra, shorter, more incrassate antennæ, less prominent tempora, differently shaped and less transverse prothorax, and in other characters.

In this species the small tubercles of the head and prothorax show plainly their origin in simple asperities at the anterior margins of the punctures, and, in both *arenarius* and *pallens*, the declivous anterior part of the pronotum is less abruptly defined than in the others here described.

#### **TANARTHURUS** Lec.

This is a singular and isolated type of the Anthicini, not very closely related to any other, but agreeing better with *Anthicus* than with any of those genera which have an abnormal extension of the mesosternum. Its divergence from *Anthicus* is, however, very marked in the depressed body with subtruncate and more or less abbreviated elytra, in peculiarities of tarsal and palpal structure previously noted, in the smaller and distinctly less coarsely faceted eyes, and in the remarkable bilobed ultimate joint of the antennæ, the constriction in some species being so deep that it is almost impossible to decide at once whether or not it really separates the one joint into two.

The sculpture of the integuments is also worthy of remark. The punctures of the head and pronotum are shallow and varicillate, except in *Tanarthrus* proper, and, in all but one of *Tanarthropsis*, each puncture is accompanied by a small but pronounced and shining tubercle. The surface of the elytra is covered closely with a reticulation of fine lines, and, besides this sculpture, there are frequently two independent sets of punctures, one very minute and bearing the visible hairs, and the other still very small but large by comparison, which are circular, shallow and crater-form, either nude or bearing extremely minute setæ only visible under considerable amplification. Some species have, besides the reticulation, only one set of minute punctules each of which bears a hair, the singular varioles being completely wanting. This character, in conjunction with the varying length and apical structure of the elytra, shape of the head, size of the eyes and structure of the



epistoma, enables us to discriminate the rather closely allied forms related to *salicola*.

The species are generally found running rapidly on soft saline mud, and those discovered thus far may be distinguished as follows:—

- Antennæ long, the last joint much narrower, elongate, cultriform and feebly bilobed; tibial spurs very long; tarsi longer and thicker, the anterior somewhat dilated;—subgenus *TANARTHURUS* Lec.....1. **salinus**
- Antennæ much shorter and submoniliform, the last joint not narrower and much shorter, acorn-shaped; tarsi shorter, very slender and filiform throughout in both sexes; tibial spurs shorter;—subgenus *TANARTHROPSIS* n. n.
- Elytra with a single set of minute pubiferous punctures, pale, fasciate with black.
- Elytra very much abbreviated, exposing at least one-third of the abdomen; basal impression of the head broad and very feeble.
- Elytra dehiscent, obliquely and anteriorly truncate toward the sutural angles at apex, the angles obtuse.....2. **brevipennis**
- Elytra not dehiscent, apparently connate throughout, semicircularly rounded at apex.....3. **nubifer**
- Elytra longer, leaving merely the tip of the abdomen exposed, feebly dehiscent and broadly arcuato-truncate at apex; basal impression of the head narrow and strong.....4. **tricolor**
- Elytra with shallow variolate punctures of larger size scattered among the minute pubiferous punctures.
- Elytra pale, fasciate with black, covering all but the tip of the abdomen, distinctly dehiscent and evenly arcuato-truncate at apex; head and pronotum granulose; basal impression of the head narrow and pronounced.
- Elytra slightly shining but alutaceous, with a narrow nubilata fascia at the middle; apex pale.....5. **salicola**
- Elytra densely opaque, with a median and apical fascia of deep black; body narrower, the head much smaller .....6. **densus**
- Elytra black throughout, exposing slightly more of the tip of the abdomen, narrowly dehiscent at apex; body much smaller and entirely black; head and pronotum sparsely and very shallowly punctate, without trace of granulation.....7. **alutaceus**

Subgen. **Tanarthrus** Lec.

1. **T. salinus** Lec.—Ann. Lyc. Nat. Hist., N. Y., V, p. 156; Proc. Acad., Phila., 1852, p. 104.

Subparallel, depressed, polished throughout, rufo-testaceous, the elytra slightly clouded with blackish near the scutellum; pubescence moderately long, fine, decumbent and distinct, the tibiæ and tarsi bristling with long erect setæ. Head large, subquadrate,

fully as long as wide, feebly convex, truncate and strongly, canalicularly impressed at base, the angles very broadly and obliquely rounded; tempora thence long and parallel to the eyes, which are very small and somewhat feebly convex; punctures fine, simple and sparse; antennæ long, filiform, not at all incrassate, as long as the head and prothorax, the joints inflated at apex and very narrow at base, the last joint abruptly much narrower, slender, very feebly bilobed and as long as the three preceding together; maxillary palpi slender, the last joint but slightly longer and wider than the third, obliquely truncate at apex. Prothorax trapezoidal, widest and moderately narrowly rounded at apical fourth, about as long as wide and distinctly narrower than the head; sides moderately oblique and nearly straight; apex broadly arcuate; disk depressed, minutely and sparsely punctate, with a coarse and deep rounded groove along the basal margin. Elytra two-fifths longer than wide, three-fourths wider than the prothorax, broadly and almost semi-circularly rounded in apical fifth, not dehiscent, leaving one-third of the abdomen exposed, distinctly wider behind the middle than at base, the sides almost straight; humeri rounded, rather widely exposed at base; disk with a distinct intra-humeral impression but not otherwise modified, somewhat densely punctate, not reticulate, the punctures fine and pubiferous, mingled with others which are a little larger and shallow, bearing exceedingly minute setæ. Abdomen polished, finely, sparsely and subasperately punctate. Legs very long, rather slender. Length 5.0 mm.; width 1.65 mm.

California (southern salt lakes). This species is the most remarkable of the tribe, not only in size but in many points of structure. The male has the fifth ventral scarcely longer than the fourth, broadly and distinctly sinuate at the middle of the wide apex, the genital segment relatively somewhat small, evenly and feebly convex, truncate at apex; the exposed part of the œdeagus consists of two lateral rounded laminate lobes and a more slender median part, which is abruptly bent upward at apex.

Subgen. **Tanarthropsis** Csy.

2. **T. brevipennis** n. sp.—Narrow, subparallel, depressed, dull, the elytra alutaceous, pale rufo-testaceous, the abdomen piceous beneath, blackish above, the elytra blackish, paler at apex and in basal third; pubescence fine short, rather sparse, longer and more cinereous, denser and more conspicuous on the elytra, decumbent. *Head* quadrate, as long as wide, truncate but

only obsoletely impressed at base, the angles broadly rounded; tempora subparallel, long and arcuate; eyes very small, not quite as prominent as the tempora; disk reticulate, finely, feebly punctate, the punctures granuliferous only toward the sides; median line narrowly impunctate; antennæ short, scarcely incrassate, one-third longer than the head, the last joint not as long as the two preceding, bisected behind the middle, somewhat acorn-shaped second and third longer than the following. *Prothorax* nearly as long as, wide, distinctly narrower than the head, narrowly rounded and widest near the apex, the sides thence strongly oblique and feebly arcuate, becoming slightly sinuate to the basal margin which is distinct and defined by a fine impressed line, not distinctly dilated laterally and three-fourths as wide as the disk; apex broadly, strongly arcuate; collar very broad but short, cylindrical; disk moderately convex, somewhat swollen just before the basal margin, sculptured like the head but rather more densely, the punctures feeble or wanting in a narrow median area toward base. *Elytra* very short, scarcely two-fifths longer than wide, one-half wider than the prothorax, distinctly wider behind the middle and at apex than at base, the sides feebly arcuate; humeri well exposed at base; disk flat, minutely, densely punctate. *Abdomen* shining, finely feebly and sparsely punctate. *Legs* rather short and somewhat stout, the tarsi short and very slender. Length 3.0 mm.; width 0.85 mm.

Arizona (Holbrook).

This species is distinguishable by its very short truncate elytra, and differs from every other in having the elytral pubescence streaming out perpendicularly from the suture in basal third and inner half. The exposed part of the tergum consists of a very large convex, finely and sparsely punctate segment, parabolically rounded behind and having, near the base, two transverse and densely pubescent patches nearly trisecting the width, analogous perhaps to those of the *Omalini* or at least similar in origin and purpose. The single specimen is a female, kindly given to me by Mr. Roberts and probably collected by Mr. Wickham.

3. ***T. nubifer*** n. sp.—Narrow, parallel, depressed, dull, the elytra paler and less dull, pale rufo-testaceous, the abdomen above and beneath blackish; elytra more flavate, with a common scutellar spot and another similar on each behind the middle, blackish; pubescence short, decumbent, rather close, more distinct on the elytra where it is even and longitudinal in direction throughout. *Head* not quite as long as wide, truncate and feebly, medially impressed at base, the angles broadly rounded; tempora somewhat swollen and rounded, long, rather more prominent than the eyes which are very small; punctures very shallow, dense and tuberculiferous; epistoma narrowly prolonged and polished; antennæ nearly one-half longer than the head, moderately slender, feebly incrassate, joints two to six uniformly decreasing in length, the eleventh bisected behind the middle, nearly as long as the two preceding, the tenth scarcely as long as wide. *Prothorax* quite distinctly narrower

than the head, much wider than long, semi-circularly rounded laterally in apical half, the sides thence strongly oblique, becoming sinuate to the basal margin, which is narrow and only two-thirds as wide as the disk; apex broadly arcuate; sculpture similar to that of the head but coarser, the punctures large and very shallow, scarcely more than areolæ at the inner sides of the small tubercles. *Elytra* short, one-half longer than wide, one-half wider than the prothorax, connate throughout, semi-circularly rounded behind in fourth or fifth, the sides parallel, not wider behind the middle than at base; humeri widely exposed at base; disk not at all modified at base, very feebly convex, minutely, densely punctate, the suture somewhat elevated behind. *Abdomen* coarsely, sparsely pubescent, the legs moderately long and slender. Length 3.0 mm.; width 0.75 mm.

Utah (Great Salt Lake).

A distinct species also represented before me by the female only, this sex having the exposed part of the tergum feebly convex, parabolic at apex, and with a minutely pubescent and narrow line near the base, extending almost entirely across the disk and narrowly interrupted in the middle.

4. **T. tricolor** n. sp.—Narrow and subdepressed, alutaceous, pale rufo-testaceous, the elytra and abdomen pale luteo-flavate, the former crossed just behind the middle by a narrow piceous fascia; pubescence rather short, decumbent, close and distinct on the elytra. *Head* subquadrate, nearly as long as wide, truncate at base and somewhat strongly, subcanalicularly impressed in the middle, the angles broadly rounded; tempora long, parallel and rather rounded, fully as prominent as the eyes, which are small; sculpture close and granular; antennæ slender, scarcely one-half longer than the head, feebly incrassate, the eleventh joint rather longer than the preceding two, fourth slightly shorter than either the third or fifth. *Prothorax* scarcely three-fourths as wide as the head, nearly as long as wide; sides evenly but rather prominently rounded at apical third or fourth, thence strongly convergent, becoming sinuate and parallel to the base, which is somewhat broadly margined and about three-fourths as wide as the disk, the latter moderately convex and granularly rugose. *Elytra* rather more than one-half longer than wide and about two-thirds wider than the prothorax, abruptly arcuato-truncate and distinctly dehiscent at apex; sides parallel and feebly arcuate, the disk not much wider behind the middle than at base, finely, densely punctate, with a very feeble post-scutellar impression; humeri moderately exposed at base and rounded. *Abdomen* shining, finely, rather closely punctate, the legs moderately long and slender. Length 3.0 mm.; width 0.8 mm.

Utah.

Closely allied to *salicola*, but distinguishable by the elytral sculpture, smaller eyes and more swollen and more prominent tempora; the tip only of the tergum is exposed in the female, and

this is rather closely punctured and pubescent. The epistoma is short, the suture distinct and broadly angulate, the basal three-fifths corneous and sculptured like the adjoining front, the apical two-fifths abruptly thin, transparent and devoid of sculpture.

5. **T. salicola** Lec.—Trans. Am. Ent. Soc., V, (1875), p. 174.

Nearly similar to the last in general form and coloration, but with larger and more convex eyes and straight parallel tempora behind them, the clypeus longer, less sculptured, divided by a feebler and more arcuate suture, the apex of the thin portion narrowly grooved. Prothorax distinctly larger when compared with the head and more broadly rounded at the sides anteriorly. Elytra covering virtually the entire abdomen in the male, parallel, rather flat, one-half longer than wide, three-fourths wider than the prothorax, alutaceous, the pubescence somewhat sparse. Under surface of the hind body intense black throughout, the legs pale testaceous. Length 3.0 mm.; width 0.9.

Utah,—Cab. LeConte. The male has the fifth ventral not quite as long as the fourth, broadly truncate at apex, the truncature broadly and feebly sinuate in the middle. The under surface of the hind body in *tricolor* is very pale throughout, the abdomen being rather more closely punctate than in *salicola*, and, as usual in this section, there are two longitudinal series of long tactile setæ, two setæ to each segment. The dusky tip of the elytra, referred to in the original description, is due to the black apex of the abdomen by diaphaneity; in the following species, however, the tip is really black.

6. **T. densus** n. sp.—Narrow, subdepressed, opaque throughout above, the abdomen shining, dark rufous, the under surface of the hind body deep black; pygidium black; elytra with a black band just behind the middle which is expanded posteriorly at the side margins, joining a narrow black apical band; pubescence very short, decumbent, even, moderately dense and not very conspicuous. *Head* subquadrate, not quite as long as wide, truncate and medially subcanaliculate at base, the angles rounded; tempora long, becoming straight and parallel for some distance behind the eyes, the latter moderately small, convex, more prominent than the tempora; disk finely, granularly punctate; antennæ rather thick, very feebly incrassate, fully one-half longer than the head, the eleventh joint as long as the two preceding combined, deeply constricted behind the middle, the basal lobe as usual thicker. *Prothorax* somewhat small, much narrower than the head, noticeably wider than long, widest and rather strongly rounded between apical third and fourth, the sides thence oblique and straight, becoming parallel only just before the

base; margin very narrow; apex broadly, circularly arcuate; collar short and broad; disk rather convex, densely and strongly granulato-rugose. *Elytra* nearly two-thirds longer than wide and about two-thirds wider than the prothorax, the sides parallel and almost straight, slightly arcuate in the female, dehiscent and broadly rounded at apex; humeri well exposed at base; disk even, finely, very densely and compositely sculptured and opaque. *Abdomen* shining, finely, sparsely punctulate, the legs moderately long and slender. Length 2.9 mm.; width 0.75 mm.

Utah (Great Salt Lake). Hubbard and Schwarz.

The description is drawn from the male, this sex having the fifth ventral rather shorter than the fourth, broadly truncate at apex, with a very feeble sinuation and with a slightly thickened bead-like edge toward the middle; only the pygidium is exposed at apex.

Besides the denser, more opaque and differently ornamented elytra, this species differs from *salicola* in its relatively smaller head and coarser sculpture of the pronotum.

7. ***T. alutaceus*** Lec.—Ann. Lyc. Nat. Hist., N. Y., V, p. 155 (Anthicus); Proc. Acad., Phila., 1852, p. 104 (Tanarthrus).

Narrow, feebly convex, rather shining and scarcely distinctly reticulate, black throughout, the antennæ and legs in part paler; pubescence fine, very short and not dense. Head fully as long as wide, broadly arcuate and not distinctly impressed at base; the angles very broadly rounded to the small, anterior but somewhat convex eyes; punctures large, very shallow and sparse, without trace of a median smooth line; antennæ short, moniliform one-third longer than the head, the subdivided eleventh joint as long as the two preceding. Prothorax trapezoidal, the sides oblique and straight and the apex broadly arcuate, rather small, much narrower than the head and slightly transverse, the punctures large, very shallow and sparse. Elytra one-half longer than wide and three-fifths wider than the prothorax, with unevenly and sparsely scattered, shallow, craterform areolæ, the hairs arising from almost imperceptible punctures of the interspaces. Metasternum highly polished. Abdomen shining, not distinctly punctured. Legs slender, moderate in length. Length 2.2 mm.; width 0.55 mm.

California (San Diego). This species differs greatly from the others of the subgenus in its small size, feeble sculpture, more

shining integuments, black color, rather more convex eyes and other characters.

### **NOTOXUS** Fabr.

This genus contains numerous species in North America, but is more abundant in the temperate than in the tropical regions of the continent. The thirty-two species included in the table below, appear to be rigorously definable and without suspicion of intergradation, as far as can be observed with the abundant material before me. The species in fact seem to be unusually constant through long series, in the majority of cases even in coloration, and types of coloration have proved so stable that it is found convenient to divide the genus into groups based primarily upon these characters. It seems evident, moreover, that this may be as natural a grouping as any which can be provisionally assumed.

The thoracic horn is another character heretofore regarded as especially prone to variation, which I have found to be quite constant in general form and structure within the same sex of the various species, and this is what might be anticipated from analogy. It is true that the horn is an unusual and greatly developed structure of scarcely obvious utility in the economy of the animal, if we consider the genus in relation to the other genera of Anthicini; but, on the other hand, we must remember that within the large genus *Notoxus*, the horn, whatever its use, whether a protection for the head or something more obscure, is a remarkably characteristic generic feature, and consequently a long established and permanent structure, and ought not to possess much specific variability at the present time.

The species may be readily recognized as follows:—

|  |    |
|--|----|
| Elytra entirely black, sometimes feebly and indefinitely paler toward the apex.....  | 2  |
| Elytra black, each with two large oblique spots of pale tint.....  | 3  |
| Elytra black, crossed by two pale fasciæ.....  | 4  |
| Elytra more or less pale, with a single dark fascia behind the middle, which is generally produced anteriorly along the suture to a greater or less degree, frequently also with dark markings anterior to the fascia..... | 5  |
| Elytra pale, with a dark fascia at the middle, and another which is either apical or subapical.....  | 15 |
| <b>2</b> —Elytral vestiture uniform in color; eyes larger and more prominent.  |    |

**bicolor** Say

Elytral vestiture coarser, white, with a large spot at the middle of each in which the pubescence becomes abruptly brown in color.

**schwarzi** Horn

3—Thoracic process narrow; elytra truncate in the female, (*elegantulus* Laf., *subtilis* Lec.).....**talpa** Laf.

Thoracic process broader and more rapidly acuminate toward tip; elytra rounded at apex in both sexes.....**nuperus** Horn

4—Pale fasciæ situated respectively before and behind the middle.

Anterior fascia invariably interrupted at the suture.....**bifasciatus** Lec.

Anterior fascia entire and even.

Prothorax of normal size; elytral punctures dense.

Elytral apices normally rounded in the female.....**balteatus** n. sp.

Elytral apices dehiscent and individually acute in the female.

**montanus** n. sp.

Prothorax very small; elytra unusually elongate; elytral punctures sparse, the lustre polished.....**microcerus** n. sp.

Pale fasciæ situated one at the base, the other at basal third; punctures sparse; surface polished; vestiture uneven, forming two broad paler bands on the elytra.....**spatulifer** n. sp.

5—Elytral punctures sparse and frequently coarse; species generally small...6

Elytral punctures dense and generally fine.....7

6—Transverse fascia at the usual position three-fifths from the base.

Fascia distinctly denuded of pubescence.

The fascia vaguely continued along the suture to a single large indistinct scutellar spot; elytral punctures very coarse and sparse; vestiture coarse and widely dispersed.....**denudatus** Horn

The fascia not prolonged; a faint anteriorly arcuate subbasal fascia interrupted at the suture generally evident.....**debilitans** n. sp.

Fascia not denuded.

Thoracic process not or very obsoletely dentellate.

Vestiture coarse and conspicuous; elytra more elongate, the prothorax relatively smaller; antennæ stout toward apex; eyes larger and more finely faceted.....**conformis** Lec.

Vestiture finer, sparser and less conspicuous; elytra shorter and broader, with evidently finer punctuation; antennæ slender.

**sparsus** Lec.

Thoracic process distinctly dentellate.....**lustrellus** n. sp.

Transverse fascia at apical fourth very vague, the entire surface frequently obscure; larger species, with coarse and sparse punctuation.

**nevadensis** n. sp.

7—Transverse fascia more posterior in position, at apical fourth, continued along the suture to the base .....**anchora** Hentz

Transverse fascia at three-fifths from the base, not continued on the suture more than slightly beyond the middle.....8

8—Thoracic process broader, always distinctly dentellate.....9

Thoracic process narrower and elongate, never dentellate or only very indistinctly so.....14



- 9—Elytra with two more or less definite and approximate, but non-coalescent, dark spots very near the base .....10  
 Elytra each with a small subsutural spot at some distance behind the scutellum .....13
- 10—Elytra without maculation between the transverse band and basal spots, except occasionally near the lateral edges .....11  
 Elytra with a posteriorly arcuate transverse band between the fascia and the base, which is composed of six short longitudinal dashes of slightly darker brownish-piceous tint; subbasal spots also pale brown, large and indefinite .....12
- 11—Subbasal spots prolonged obliquely outward, enclosing the pale humeri; erect hairs of the elytra very long and bristling; thoracic process strongly constricted at base.....**humboldti** n. sp.  
 Subbasal spots not obliquely prolonged.  
 Thoracic process narrower and more gradually acuminate, not or feebly constricted at base and generally differing but little sexually.  
 Elytra each with a subapical diffused spot of darker tint, (vars. *pilatei* and *decoloratus* Laf.).....**monodon** Fab.  
 Elytra invariably pale behind the transverse fascia.  
 Erect hairs of the elytra shorter and more inconspicuous; transverse fascia more even; vestiture finer and more decumbent.  
 Thoracic process moderate in size; sides of the elytra invariably pale.  
 Body stout, the black fascia extending almost to the sides.  
**austinianus** n. sp.  
 Body narrow, the black fascia scarcely extending at all beyond the median line of each elytron, and having the form of two inverted commas.....**filicornis** n. sp.  
 Thoracic process very large, often fully one-half as wide as the prothorax; sides of the elytra dark.....**dinocerus** n. sp.  
 Erect hairs very long and bristling; vestiture coarser; fascia narrower and acutely zig-zag.....**desertus** n. sp.  
 Thoracic process broadly spatuliform, strongly constricted at base at least in the female.  
 Smaller species, the elytral apices simple in the male.  
**constrictus** n. sp.  
 Large species, the apices narrowly truncate in the male...**robustus** n. sp.
- 12—Transverse fascia broad, interrupted at the suture, (*digitatus* Lec.).  
**serratus** Lec.
- 13—Transverse fascia much broken up .....**alamedæ** n. sp.
- 14—Elytra with a transverse band between the fascia and the base, which is prolonged posteriorly along the suture joining the fascia; body narrow, elongate and parallel.....**pictus** n. sp.  
 Elytra without the intermediate band.  
 Elytral apices dark in color, the sides behind basal third also dark; larger species, (*marginatus* Lec.).....**apicalis** Lec.  
 Elytral apices pale as usual; small species; fascia feeble in tint, nubilata and strongly zig-zag.....**cavicornis** Lec.

**15**—Crest of the thoracic process abrupt and well defined by a continuous elevated margin; larger species, the posterior fascia small, irregular and very near the apex.....**calcaratus** Horn

Crest subobsolete, represented only by a few detached asperate points; posterior fascia at apical fifth; elytra with erect setæ; small species.

**delicatus** Csy.

Crest completely obsolete, the posterior fascia large and enveloping the apices; median fascia greatly prolonged along the suture, becoming bifurcate; elytra without erect setæ .....**planicornis** Laf.

The characters of *planicornis*, which is the only species not before me, are taken from the figure given by LaFerté; this figure does not, however, at all agree with the description, which states that there is a small scutellar spot, a median sinuous fascia and another ante-apical, which is composed of two lunules; this would make the markings agree nearly with those of *delicatus*, but as the description states that there are no "poils raides" in *planicornis*, and as these are very evident in *delicatus*, I prefer to regard the two species as distinct for the present. As I have before explained (Bull. Cal. Acad. Sci., I, p. 333), *delicatus* is in no way closely related to *monodon* or *pilatei*.

I have considered *pilatei* and *decoloratus* of LaFerté as varieties of *monodon* for the present, as I have not been able to identify them, but it is more than possible that they represent valid species.

The genus having been so recently reviewed by Dr. Horn (Tr. Am. Ent. Soc., XI, 1884, p. 165), it is only necessary at the present time to describe the species announced as new in the above table.

**N. balteatus.**—Moderately stout and shining, rufo-piceous, the elytra black with a broad and even transverse fascia at basal third, and another, equally straight and transverse but narrower, at apical third; basal margin and apex also paler; vestiture very fine, short, even and only moderately close anteriorly, coarser and denser on the elytra, where it is pale cinereous on the pale bands, elsewhere brownish, without erect setæ. *Head* distinctly smaller than the prothorax, the eyes rather large, slightly longer than the tempora; antennæ distinctly longer than the head and prothorax, stout toward apex, the tenth joint but slightly longer than wide. *Prothorax* slightly transverse, subglobular, finely, closely punctate, the horn well developed, two-thirds longer than wide, very feebly narrowed at base, not dentellate, the crest strongly developed and surrounded by a fine elevated and non-dentellate border. *Elytra* three-fourths wider than the prothorax, evidently less than twice as long as wide, feebly dilated behind; disk very minutely, evenly, moderately closely punctate; humeral impression feeble; post-scutellar depression distinct. Under surface minutely and closely punctate, the legs moderately slender, testaceous. Length 3.0 mm.; width 1.0 mm.

## Arizona.

A single female specimen representing a species which is allied to *bifasciatus*, but differing in coloration and several structural characters. The configuration of the anterior pale fascia in *bifasciatus* is perfectly constant throughout my series.

**N. montanus.**—Stout, rather shining, testaceous, the abdomen darker; elytra dark piceous-brown, with a broad even and parallel-sided transverse fascia of paler tint at basal third, and another, narrower, at apical third, the latter bent forward toward the suture; base and apex also paler; vestiture short, not very dense, somewhat coarse on the prothorax, intermingled with sparse erect setæ on the elytra. *Head* much smaller than the prothorax, polished; eyes small, barely as long as the tempora; antennæ two-fifths as long as the body, moderately incrassate, the tenth joint one-half longer than wide. *Prothorax* slightly wider than long, the sides oblique to the base behind the middle; surface finely, densely and rather rugosely punctate; horn well developed, about one-third longer than wide, distinctly constricted at base, the sinuation broad, the border entire, the crest well developed, with its border strongly reflexed and entire. *Elytra* distinctly dilated and, at apical third, almost twice as wide as the prothorax, scarcely more than three-fourths longer than wide, broadly, feebly, transversely impressed at basal third, strongly impressed on the suture behind the scutellum, the humeral impression obsolete; punctures somewhat fine but distinct, rather dense. Under surface densely pubescent, minutely, densely punctate, the legs slender. Length 2.9 mm.; width 1.0 mm.

## Colorado.

This species, while allied in general appearance to some others of this group, may be distinguished by its stout form, and, from *balteatus*, by its smaller eyes, coarser punctuation and erect setæ of the elytra, these being completely wanting in that species. From *bifasciatus* it differs in its much longer and more distinct erect setæ, non-interrupted elytral fasciæ, dehiscent tips of the elytra, less incrassate antennæ and many other features. It is represented before me by the female only.

**N. microcerus.**—Rather narrow, polished, dark rufo-piceous, the abdomen black; elytra black, with a straight transverse and entire fascia just behind basal fourth, and, on each, a transverse spot at apical fourth which is flexed obliquely forward, becoming feeble, to the suture; base slightly, the apex not appreciably, pale. *Head* but slightly smaller than the prothorax, polished, the eyes well developed; antennæ long, slender, scarcely at all incrassate, more than one-half as long as the body, dark rufo-testaceous throughout, the tenth joint about one-half longer than wide on the compressed side and nearly twice as long as wide on the other. *Prothorax* small, subglobular, a little wider than long, coarsely punctato-scabrous, except broadly along the

middle, sparsely and coarsely pubescent, the transverse tomentose line at the base very widely interrupted; horn small, strongly and abruptly crested, slightly longer than wide, not constricted, evenly rounded at tip, both horn and crest surrounded by an acutely elevated and non-dentellate margin. *Elytra* elongate, twice as long as wide, very appreciably dilated at apical third and twice as wide as the prothorax, gradually narrowed and somewhat acutely parabolic in apical third, the sutural angle rounded but not at all truncate; intra-humeral impression distinct, the post-scutellar very strong; disk minutely, sparsely punctate, finely dusky-pubescent, except in the transverse fasciæ, where the vestiture is coarser and cinereous; erect setæ long but rather fine and sparse. *Abdomen* strongly shining, the minute punctures feeble. *Legs* moderate, the hind femora dusky. Length 2.7 mm.; width 0.85 mm.

Arizona (near the Cañon of the Colorado).

This is a well marked species, to be readily known by its long, polished, sparsely and minutely punctate elytra, which are narrowed obliquely behind from slightly before apical third, also by its small prothorax with an unusually small corneous process, long antennæ and other characters.

A single specimen, probably male, was recently taken by Dr. T. Mitchell Prudden, of New York, and kindly presented to me together with a number of other interesting species.

**N. spatulifer.**—Somewhat narrow, parallel, polished throughout, piceous-brown, the antennæ paler and the elytra black, the latter with the basal margin and a transverse fascia at basal third pale, the latter clothed with coarser, closer and more cinereous pubescence, a transverse band occupying apical fourth also similarly pubescent, the vestiture elsewhere fine, dark in color and very sparse; erect setæ sparse, more distinct in the cinereous areas. *Head* but slightly smaller than the prothorax, convex, polished, very remotely pubescent, the eyes small, much shorter than the tempora; antennæ one-half as long as the body, somewhat thick, just visibly and very gradually incrassate, slightly infusate toward apex, the tenth joint distinctly elongate. *Prothorax* globular, not wider than long, polished, finely and sparsely punctate throughout, the basal tomentose line scarcely at all interrupted; horn well developed, circularly rounded at apex, not dentellate, feebly but rather abruptly constricted at the middle and thence parallel to the base, narrower and scarcely at all constricted in the male; crest abrupt, moderately elevated, acutely outlined along the sides but indefinitely so anteriorly; surface of the horn concave and strongly sculptured. *Elytra* twice as long as wide and parallel in the male, shorter and slightly inflated in the female, narrowly and obliquely truncate near the suture in the former, broadly and squarely truncate throughout the width in the latter sex, scarcely more than one-half wider than the prothorax, rather sparsely and somewhat strongly but not very coarsely punctate, without basal impressions of any kind, even post-scutellar. Under surface rather coarsely and sparsely pubescent. Length 2.6–2.8 mm.; width 0.75–0.85 mm.

California (Los Angeles Co.).

A distinct species in its strongly marked sexual characters, sparse and uneven pubescence, polished surface and other characters; it is allied closely, however, to *denudatus*, a peculiar California coast species, and scarcely at all to *bifasciatus*, and is placed in the vicinity of the latter merely to facilitate identification. The last ventral of the male has a deep rounded median impression. Three specimens.

**N. debilitans.**—Moderately narrow, polished, pale piceous-brown, the elytra blackish, pale at base, obliquely more broadly toward the sides, also in a broad anteriorly arcuate fascia just behind basal third, and, less markedly, in apical fourth; vestiture sparse and rather coarse but short and subdecumbent, finer, sparser, more decumbent and inconspicuous in the black fascia and at base. *Head* distinctly narrower than the prothorax; eyes somewhat small; antennæ moderately stout, rather short, scarcely longer than the head and prothorax, the tenth joint but slightly longer than wide. *Prothorax* subglobular, slightly wider than long, minutely, remotely punctate throughout, the horn nearly as in *spatulifer*,—well developed, non-dentellate, broadly and feebly constricted toward base,—but with the concave apical part much more pointed and less broadly rounded. *Elytra* distinctly less than twice as long as wide, about two-thirds wider than the prothorax, the sides parallel, feebly arcuate behind, the apex broadly subtruncate and arcuate in the female, the outer angles broadly rounded; disk without impressions, coarsely, sparsely punctate, the erect setæ long but very sparse. *Abdomen* rather sparsely, coarsely pubescent. Length 2.5–2.7 mm.; width 0.8 mm.

California (San Diego).

Of this interesting species I obtained four specimens, which are unfortunately all females; the male, however, without doubt has the short oblique subdentate truncature characterizing the allied forms. It forms, with *spatulifer* and *denudatus*, a very distinct group of small polished and sparsely punctate species, and differs from the first in the shorter elytra, less transversely truncate in the female, in the coarser and still sparser punctures of the elytra, more pointed apex of the pronotal process, shorter antennæ and paler coloration, and, from *denudatus*, in its stouter build, different pattern of elytral ornamentation, less coarse and sparse elytral punctures and closer, more decumbent pubescence.

In *denudatus* the form of the body is very slender, the elytral punctures remarkably coarse and sparse, the vestiture of the elytra coarse, rather long, very sparse and not closely decumbent, the antennæ long, slender, gradually and distinctly incrassate, with the tenth joint much longer than wide, and the elytra fully

twice as long as wide, devoid of impression and colored as stated in the table; the fifth ventral of the male is excessively feebly or not at all impressed. In all three of these species the punctures of the elytra become very fine, remote and feeble toward apex.

**N. lustrellus.**—Somewhat stout, shining, pale piceo-testaceous, the elytra with a blackish transverse fascia scarcely before apical third and broadly interrupted at the suture, without other maculation. *Head* just visibly narrower than the prothorax, orbicular, polished, the eyes large, convex and prominent, fully as long as the tempora; antennæ slender. *Prothorax* distinctly wider than long, broadly rounded at the sides anteriorly, feebly and obliquely narrowed and sinuate thence to the base, polished, extremely minutely, sparsely punctulate, sparsely and coarsely pubescent, the basal tomentose line subinterrupted in the middle; horn long and moderately dilated, coarsely and deeply crenate throughout, the crest strongly elevated, very long and narrow, the margins distinct and crenulate, acute and feebly defined at apex. *Elytra* not quite twice as long as wide, parallel, nearly twice as wide as the prothorax, the sides becoming rather abruptly oblique and arcuate in apical fourth to the oblique apical truncature; intra-humeral impression somewhat distinct, the scutellar obsolete; disk sparsely and rather coarsely punctate, the pubescence sparse, coarse, cinereous and decumbent, almost evenly distributed, the erect setæ indistinct. Under surface coarsely pubescent. Length 2.9 mm.; width 1.05 mm.

California (San Francisco).

The single male represents a species allied to *conformis*, but differing in its shorter and broader elytra, more dilated thoracic process, strongly dentellate at the margins and with much more elongate crest, and other characters. There is a small feeble sutural spot on each elytron just in advance of the sutural break in the transverse fascia, but no trace of scutellar spot.

**N. nevadensis.**—Moderately stout, parallel, convex, shining, piceous-brown, with a large nubilate transverse fascia, interrupted at the suture, at apical fourth. *Head* much narrower than the prothorax, polished but rather distinctly pubescent and with conspicuously long sparse setæ, eyes very small, not much more than one-half as long as the tempora; antennæ moderately stout, feebly incrassate, about two-fifths as long as the body. *Prothorax* somewhat large, subglobular, slightly wider than long, sparsely, very minutely punctate and polished, the pubescence rather long but not very dense, decumbent; basal line diminishing greatly in width toward the middle but scarcely interrupted; horn well developed, parallel, not constricted at base, one-half longer than wide, rounded at apex, with the edges moderately coarsely, unevenly and rather feebly crenulate, the crest somewhat pronounced but short and wide, scarcely one-half as long as the horn, definitely limited at the sides but not at apex. *Elytra* elongate, twice as long as wide, barely two-

thirds wider than the prothorax, the sides parallel and scarcely more arcuate behind, the apex obliquely rounded from apical third; disk obsoletely impressed within the humeri and on each side of the suture near the scutellum, coarsely, sparsely punctate, finely toward apex, the pubescence rather long, coarse, sparse, cinereous, subdecumbent and evenly distributed, the erect setæ long, coarse, rather numerous and conspicuous. Under surface and legs minutely, closely punctulate, the abdomen coarsely pubescent. Length 3.0 mm.; width 1.1 mm.

Nevada (Elko). Mr. Wickham.

Three males before me agree very well among themselves and have the tips of the elytra obliquely truncate near the suture, and the fifth segment scarcely visibly and transversely impressed near the apex, but the fourth specimen, also a male, differs in form and color, having the elytra larger and longer, almost entirely blackish, and the thoracic process more strongly crenulate. I think, however, that it can only represent a varietal modification; it is labeled "Nevada," without more precise indication of locality.

**N. humboldti.**—Stout, somewhat shining, pale, ochreo-testaceous throughout, the abdomen just visibly infuscate posteriorly; elytra with two subconfluent scutellar spots, which are prolonged obliquely outward to the lateral edges, and a broad transverse fascia somewhat behind apical third, prolonged broadly along the suture, abruptly ending just behind basal third, of black; apical regions not maculate. *Head* much narrower than the prothorax, finely, densely punctate and pubescent; eyes large, much longer than the tempora; antennæ rather short and stout, the tenth joint but little longer than wide. *Prothorax* transversely oval, finely and somewhat sparsely punctate, the coarse yellowish decumbent pubescence abundant; horn strongly developed, spatuliform, gradually and strongly narrowed to base and margined throughout with large prominent and distant, obtusely rounded teeth, the crest very long and narrow, defined at the sides only by a series of elongate elevations, not defined at the acute apex. *Elytra* distinctly less than twice as long as wide, not quite twice as wide as the prothorax, not dilated behind, the sides parallel and nearly straight, obliquely narrowed and then obtusely rounded in apical third or fourth; humeral impression at base narrow and well marked, the scutellar also slightly visible; disk strongly but not very coarsely, rather closely punctate and shining, the decumbent pubescence coarse but only moderately long and dense; erect setæ abundant, very long, coarse and conspicuous throughout the upper surface. Length 3.6 mm.; width 1.25 mm.

California (Hoopa Val., Humboldt Co.).

The single specimen before me, probably female, represents an interesting modification of the *monodon* group, departing radically in type of maculation near the base of the elytra, and differing



from *constrictus* not only in this respect, but in the entire structural detail of the thoracic process and crest, and in the very long bristling setæ of the elytra.

In the species of *Notoxus* the modifications at the thoracic apex are quite complex, and seem designed in part to prevent a too great lateral motion of the head, which would thus be deprived of the protection of the thoracic process. There is, among these modifications, a small oval subdepressed area at each side just behind the apical margin, which has the bottom convex and very densely sculptured and pubescent; this is especially developed in *constrictus*, but is very small in the present species; it is perhaps connected in some way with a lateral enlargement of the neck within the prothorax.

**N. austinianus.**—Somewhat stout, pale rufo-testaceous throughout, the legs more ochreous; elytra with two feeble scutellar spots and a transverse fascia behind the middle of blackish, the latter rather narrow and flexed toward the suture to the middle; lateral spots wholly obsolete. *Head* not perceptibly narrower than the prothorax, minutely, closely punctate and pubescent, reticulate and dull, the eyes large, much longer than the tempora; antennæ stout, two-fifths as long as the body, gradually and distinctly incrassate, the tenth joint obconical, much longer than wide. *Prothorax* small, globular, minutely and moderately closely punctate, polished, the vestiture fine, decumbent, not concealing the surface, more evident along the median line; basal line very wide laterally, broadly subinterrupted at the middle; horn well developed, broad, rather finely dentellate, only very slightly wider in the female, not distinctly narrowed at base, the crest strongly elevated and defined throughout by an acute entire border. *Elytra* not quite twice as long as wide, at posterior third sensibly dilated and nearly twice as wide as the prothorax, broadly, evenly rounded behind in both sexes; disk scarcely at all impressed at base, finely, deeply, closely punctate and dull, the vestiture somewhat coarse, decumbent, cinereous, dense and evenly distributed, the erect setæ abundant, but not very coarse and decidedly short. Under surface finely, very densely pubescent, the abdominal segments more coarsely so along the apices. Length 2.7–3.5 mm.; width 1.0–1.25 mm.

Texas (Austin).

The male differs scarcely at all from the female. *Austinianus* is one of the allies of *monodon*, and differs in its shorter, finer, denser and more even vestiture, narrower posterior fascia, without a subapical black cloud, much larger eyes, polished surface of the pronotum, not concealed by the vestiture, and in other features constituting a general facies. It is represented by a large and homogeneous series.



**N. filicornis.**—Slender, convex, rather dull, pale luteo-flavate throughout, the elytra with a feeble rounded darker spot at each side of the suture behind the scutellum, and a darker median spot just before apical third, the latter with an oblique ramus extending anteriorly to just beyond the middle gradually approaching but not touching the suture, the spot not at all extended laterally; pubescence somewhat coarse and dense, cinereous-white, decumbent, with distinct and rather numerous erect bristles. *Head* as long as wide, dull and minutely, densely punctato-scabrous, the eyes large, at much more than their own length from the base; antennæ long, fully one-half as long as the body, very feebly incrassate toward apex, the tenth joint one-half longer than wide, the eleventh slender, almost as long as the two preceding, gradually narrowed in apical half. *Prothorax* slightly narrower than the head, somewhat longer than wide, globularly convex, polished, minutely punctate, abundantly pubescent, the basal pubescent area rapidly narrowed and almost obsolete toward the middle; horn subconical in outline, not in the least constricted, the sides arcuate, finely and rather feebly crenulate, the apex obtusely rounded in the male, more rapidly and acutely pointed in the female, a little broader and parallel toward base in the latter sex; crest short and wide, moderately elevated, outlined by a broken series of feeble crenelures. *Elytra* twice as long as wide, fully three-fourths wider than the prothorax, rounded behind in both sexes, only slightly wider at posterior third than at base, rather finely but closely and strongly punctate. *Abdomen* dull, the legs slender. Length 2.7–2.8 mm.; width 0.8–0.9 mm.

Florida (Jacksonville). Mr. Ashmead.

The male has the fifth ventral broadly subtruncate at apex, extremely feebly sinuate for a short distance at the middle, the surface adjoining the sinuation feebly and transversely impressed, in the female longer and evenly rounded, with the surface unmodified. The antennæ of the female do not differ appreciably.

This species is allied to *monodon*, but is much narrower, with longer and more slender antennæ and quite different elytral ornamentation; the spot on each elytron, with its oblique curving ramus, has the exact form of an inverted comma, and differs from any other of the *monodon* group in not extending at all toward the sides of the elytra. It seems to be allied to *pilatei* Laf., but is much smaller, the stated dimensions of *pilatei* being 3.6×1.0 mm.

**N. dinocerus.**—Narrow, convex, pale rufo-testaceous throughout, the abdomen infusate; elytra with two small scutellar spots, a transverse fascia at apical two-fifths prolonged along the suture beyond the middle, and a dark post-humeral marginal line, prolonged to the fascia or nearly to the apex, of black. *Head* as wide as the prothorax, minutely, densely punctate and dull, densely clothed with short appressed silvery pubescence; eyes large, longer than the tempora; antennæ moderate, feebly incrassate. *Prothorax* globular,

the polished surface minutely, not densely punctate and not entirely concealed by the vestiture; basal tomentose line wide laterally but subobsolete in the middle; horn very broad and strongly developed, one-half as wide as the pronotal disk in the female, slightly narrower in the male, not constricted at base, rounded, finely dentellate, densely asperate, the crest moderately elevated and defined by a somewhat broken elevated margin laterally, not defined at the apex. *Elytra* about twice as long as wide in the male, rather shorter in the female, slightly wider at apical third and nearly twice as wide as the prothorax, rounded at apex in both sexes; humeral impression very feeble, the scutellar obsolete; disk finely and closely punctate but not very dull, the pubescence dense, even, whitish and somewhat coarse; erect setæ abundant, moderate in length. Length 2.7 mm.; width 0.8 mm.

Texas (Galveston).

This species is also allied to *monodon*, differing in its smaller size, narrower form, larger thoracic process, whiter pubescence, larger eyes and still more minute and much denser elytral punctures; the sides of the prothorax are more oblique anteriorly, the horn being much more gradually formed than in *monodon*. It is represented by three specimens, in which the sexual characters are very feeble.

**N. desertus.**—Rather stout, slightly shining, pale yellowish-testaceous throughout, the elytra with a small spot at each side of the suture near the base, and a transverse zig-zag fascia behind the middle, strongly produced anteriorly along the suture beyond the middle, frequently subuniting by a feeble ray with each of the subbasal spots; sides behind the humeri faintly darkened. *Head* subequal in width to the prothorax, densely pubescent, minutely punctate, reticulate, somewhat dull, the eyes rather large, equal in length to the tempora; antennæ slender, slightly incrassate, fully two-fifths as long as the body. *Prothorax* rather small, globular, finely and sparsely punctate, shining through the somewhat dense vestiture, the basal line dilated at the sides; horn well developed, differing somewhat noticeably in the sexes; in the male smaller and narrower, more acuminate, not at all constricted at base and coarsely, deeply dentellate, in the female larger and broader, feebly and finely dentellate, broadly rounded and almost entire toward apex, feebly narrowed at base; crest abrupt, strong, limited throughout by a strongly elevated, acute and entire ridge. *Elytra* distinctly less than twice as long as wide, twice as wide as the prothorax, broadly rounded behind in both sexes, the sides parallel and almost evenly arcuate throughout; humeral impression very feeble, the scutellar wanting; disk densely, deeply and rather coarsely punctate, the decumbent pubescence coarse, whitish, moderately dense, the erect setæ long, very abundant, coarse and conspicuous. Under surface densely pubescent as usual. Length 2.7–3.5 mm.; width 1.0–1.15 mm.

Arizona (Tucson).

This is a well marked species of the *monodon* group, easily dis-

tinguished by its coarse elytral punctures, hispid appearance and coloration. It is represented by four specimens.

**N. constrictus.**—Moderately stout, scarcely shining, pale ochreo-testaceous throughout, the head frequently, the abdomen seldom, darker; elytra fasciate. *Head* equal in width to the prothorax, narrower in the female, minutely punctate, reticulate, densely pubescent and dull; eyes large, longer than the tempora; antennæ somewhat slender, moderate in length. *Prothorax* subglobular, slightly wider than long, the sides oblique and sinuate behind; disk rather coarsely, closely punctate, densely and coarsely pubescent; horn well developed, similar in the sexes, somewhat coarsely and deeply crenulate, broadly rounded and entire for a short distance at apex, widely dilated, strongly constricted at base, the crest broad, abruptly elevated, broadly rounded at apex and strongly defined throughout the sides and apex by an elevated black and entire ridge. *Elytra* a little less than twice as long as wide, distinctly dilated at apical third and three-fourths wider than the prothorax, evenly rounded at apex, a little more broadly so in the male, the humeral impression very feeble; disk densely and rather coarsely punctate, densely clothed with coarse yellowish pubescence, the erect setæ somewhat long, coarse, numerous and conspicuous. Under surface densely and rather coarsely pubescent. Length 2.5–3.5 mm.; width 0.95–1.2 mm.

California (coast regions).

The sexual differences at the posterior extremity of the body are almost completely undeveloped, and exist only in the slightly more truncate elytra of the male. This species, which is represented by a large series, has been heretofore almost universally confounded with the eastern *monodon*, which it strikingly resembles in facies. It is however widely and constantly distinct in the form of the thoracic process, as may be seen at a glance if the separated series be even casually examined. The elytral maculation is nearly as in *monodon*, except that the subapical black cloud on each elytron, which is almost constantly present in that species, is here quite as constantly absent. In the vicinity of San Diego there is, however, a variety of *constrictus* which has the lateral and subapical dark patches frequently visible, and the thoracic punctures a little finer and sparser, agreeing rigorously with the northern forms in the structure of the thoracic process, except possibly that it is a little more pointed as a rule.

**N. robustus.**—Very stout, dull from the density of the vestiture, pale ochreo-testaceous throughout, each elytron with a large rounded scutellar spot and a transverse fascia at apical third, abruptly interrupted very near the suture, but prolonged narrowly along the latter slightly beyond the middle. *Head* very much smaller than the prothorax, finely, closely punctate but shin-

ing through the close yellowish vestiture, having a long row of asperities at each side a little above the eyes, the latter moderate, about equal in length to the tempora; antennæ slender, scarcely at all incrassate and but little longer than the head and prothorax. *Prothorax* transversely oval, oblique and sinuate near the base, the tomentose line moderately wide at the sides; disk finely but strongly, rather closely punctate, the vestiture long, coarse and abundant; horn well developed, broad, parallel, rounded at apex, not noticeably narrowed at base and strongly crenate, the teeth very coarse toward tip; crest strongly elevated, defined by a strongly elevated and somewhat uneven marginal line. *Elytra* three-fourths longer than wide, two-thirds wider than the prothorax, the sides parallel and nearly straight to apical two-fifths, then gradually oblique and broadly rounded to the inwardly oblique apical truncature; humeral impression subobsolete; disk finely, densely punctate but somewhat shining, the vestiture dense, moderately long, not very coarse, the erect setæ long, coarse and abundant. Length 5.0 mm.; width 1.6 mm.

California (Lake and Los Angeles Cos.).

This is the largest and stoutest species of the genus within our boundaries, and is somewhat similar in facies to some of the relatives of *monodon*, but is very distinct by reason of the truncate tips of the elytra in the male. The male type described above is from Lake Co., but the female before me from Los Angeles is similar throughout, except that the thoracic process is broadly dilated, rounded, and strongly constricted at base, and the elytra have, at each side just behind the humeri, an inwardly and posteriorly oblique dash of black. The male has the fifth ventral truncate at tip, with its surface broadly flattened near the truncature.

From *serratus*, to which it is allied more closely than any other described species, *robustus* may be distinguished at a glance by its larger size and stouter form, more strongly constricted thoracic process of the female, longer and narrower crest, and in peculiarities of elytral ornamentation. In *serratus* the thoracic crest is very short.

**N. alamedæ.**—Stout, convex, rather shining, testaceous, the head darker, the elytra with a subsutural spot on each at basal fifth, and a transverse, very uneven and widely interrupted fascia at apical third, which is obliquely, more or less incompletely and indistinctly prolonged to the suture just before the middle, of black. *Head* scarcely in the male, very distinctly in the female, narrower than the prothorax, finely pubescent, the eyes moderate, prominent, not quite as long as the tempora; antennæ long, slender, gradually and distinctly incrassate, fully two-fifths as long as the body. *Prothorax* distinctly transverse and oval in both sexes, finely, not very closely punctate, coarsely pubescent, the tomentose line almost equal in width

throughout; horn differing greatly in the sexes, strongly, closely, moderately coarsely and evenly dentellate throughout, broadly rounded, expanded, strongly constricted at base, narrow in the male, very broadly patellate in the female; crest very long, narrow, defined at the sides by a strongly crenulate raised line, undefined at apex. *Elytra* twice as long as wide, rather less in the female, somewhat oval and convex, the sides parallel and feebly, equally arcuate, obtusely rounded behind, narrowly and obliquely truncate in the male; humeral impression feeble; punctures not coarse but strong, moderately distant; decumbent pubescence rather short, but somewhat coarse and close; erect setae long but fine, sparse and inconspicuous. Length 2.9–3.4 mm.; width 1.0–1.4 mm.

California (Alameda Co.).

The peculiar oval convex form of the elytra, and departure from the usual type of ornamentation will readily distinguish this species from *serratus* and *robustus*, to which it is somewhat related. It is smaller than *serratus*, with a much longer, narrower and more ill-defined thoracic crest and shorter, more oval and convex elytra. The female is much stouter than the male. It is represented by three specimens.

**N. pictus.**—Narrow, elongate and parallel, rather dull, piceo-testaceous, black beneath, the legs and antennae pale; elytra with the markings piceous the large scutellar spot frequently obsolete, the anterior fascia occasionally disintegrated into two large sublateral spots and an elongate and more posterior sutural area, the latter always joining the transverse post-median fascia; apices always pale. *Head* small, much smaller than the prothorax, the polished surface not much concealed by the moderately dense vestiture; eyes moderate, about as long as the tempora; antennae long and slender, about two-fifths as long as the body. *Prothorax* transversely oval, finely, not very densely punctate, polished, coarsely, somewhat sparsely pubescent, the tomentose line very widely and completely interrupted; horn long, narrow, not distinctly dentellate, parallel, rounded at apex, not at all constricted, the surface deeply concave and coarsely reticulate, the crest abrupt, elevated, very short, rounded at apex and defined throughout by an elevated and entire margin. *Elytra* elongate, distinctly more than twice as long as wide, one-half wider than the prothorax, the sides parallel and nearly straight, gradually rounded behind in apical third to the feebly oblique apical truncature, which is defined by a small dentiform projection; humeral impression distinct, the others wholly obsolete; disk finely, closely punctate, the vestiture moderate in length but rather coarse and dense as usual, assuming tints nearly corresponding to the ground color; erect setae somewhat short, sparse and not very conspicuous. Length 3.6–3.8 mm.; width 1.15 mm.

Washington State.

The description refers to the male, and this sex has, in addition, the fifth ventral sinuato-truncate in the middle at apex, the

adjoining surface scarcely at all modified. The female differs somewhat, having the thoracic process slightly wider and just noticeably narrowed at base, the elytra barely twice as long as wide and very broadly and obtusely rounded behind, and the elytral maculation paler and more suffused. In some of its characters *pictus* recalls *serratus*, the anterior fascia being a coalescent variation of the short dashes of that species, but the elongate, parallel elytra and non-dentellate thoracic process will always readily distinguish it. It is difficult to understand how such a conspicuous form as this could so long have been overlooked; it is represented in my cabinet by five individuals.

### MECYNOTARSUS Laf.

The differences between this genus and *Notoxus* are very radical, in spite of the general similarity of facies and possession of the pronotal process, which is so eminently characteristic of the latter; in *Mecynotarsus* it is even more elaborately developed than in *Notoxus*. But in *Mecynotarsus* the tarsi are extremely long and filiform, with the penultimate joint cylindrical and unmodified. The body is always small and of elegant form, and the upper surface is devoid of the erect tactile setæ so evident in *Notoxus*. Our species may be known by the following characters, *elegans* differing almost subgenerically from the first three:—

Upper surface clothed with fine sericeous pubescence; eyes large; antennæ very slender; thoracic horn finely and closely crenulate.

Elytra devoid of median darker area. Atlantic Coast.

Prothorax broadly rounded throughout at the sides, widest scarcely behind the middle; elytra very nearly twice as long as wide. Length 2.0 mm.

**candidus** Lec.

Prothorax widest and prominently rounded at the sides behind the middle; elytra three-fourths longer than wide.....**flavicans** n. sp.

Elytra pale testaceous, with a common sutural piceous cloud. Yuma, Cal.

Length 2.5 mm .....**delicatulus** Horn

Upper surface clothed with elongate parallel and decumbent scales, which are white on the elytra, with a conspicuous pattern of black; eyes small; legs and antennæ much shorter and stouter; thoracic horn less broad, with large distant, abrupt and quadrate marginal teeth.....**elegans** Lec.

The first two species and probably also the third, have the pronotum finely, deeply channeled along the posterior margin, the surface thence rapidly ascending to the general level and bearing

four minute setigerous tubercles, the two median more approximate and limiting a feeble depression, which is relatively much narrower in *flavicans* than in the more slender *candidus*.

**M. flavicans.**—Elongate-oval, convex, alutaceous, pale albido-flavate throughout, the eyes deep black and very conspicuous; vestiture very short, dense and closely decumbent giving a whitish bloom. *Head* longer than wide, broadly and very feebly concave, finely, closely punctate; eyes large, convex and prominent, at much less than their own length from the base; antennæ slender, filiform, nearly two-thirds as long as the body. *Prothorax* wider than long, very much wider than the head, convex, subangularly rounded at the sides behind the middle; base two-thirds as wide as the disk; horn large, longer than wide, narrowly parabolic in outline, feebly constricted at the immediate base; edges rather finely crenulate; crest feebly elevated, narrow, defined feebly by detached elongated tubercles. *Elytra* three-fourths longer than wide, barely two-thirds wider than the prothorax, parallel and nearly straight at the sides, arcuately narrowed and obtusely parabolic in apical third, with a broadly cuspiform sutural notch; humeri rounded; disk minutely, very densely punctate like the pronotum. Under surface minutely, densely punctate and pubescent, dull, the legs rather long, slender. Length 2.25 mm.; width 0.8 mm.

New Jersey (nearly opposite Philadelphia).

The fifth ventral of the male has a rounded and rather deep impression, which is larger and stronger than the homologous impression of *candidus*. *Flavicans* is a larger and evidently stouter species than *candidus*, and may be readily distinguished by the prominent sides of the prothorax.

#### XYLOPHILINÆ.

The heterogeneous components of this subfamily, while bound to the Anthicinae by certain characteristics of facies, differ very radically in tarsal and abdominal structure, and also in the form of the labial palpi as indicated in the table previously given. The species are all small and generally quite minute, but the profound structural differences of the genera lends great interest to them from a morphological standpoint. The species of the various genera adhere closely in general appearance to the type form, and will prove to be rather numerous. They are, however, quite rare in cabinets at present, chiefly because no systematic methods have been pursued in collecting them, the only exception to this known to me being the cabinet of Messrs. Hubbard and Schwarz, which contains good series of many species, carefully collected

in Florida, in which region they seem to particularly abound. There are, however, also a large number of northern Atlantic species, but only a single one is known at present from the Pacific coast. A considerable number of Mexican species have been recently described by Mr. Champion.

I have no hesitation whatever in separating our species into numerous genera, the generic characters being as pronounced as in almost any other group of Coleoptera, but as the types of *Xylophilus*, *Euglenes* and other of the older genera are unknown to me at present, I am forced to give them all distinct names, the probability being that none of them will prove entirely identical with any hitherto described.\* These genera are the following:—

- Muzzle not prolonged before the point of antennal insertion.....2  
Muzzle prolonged; body very minute.....11  
**2**—Head constricted at base; epistomal suture deep and distinct.....3  
Head not constricted at base. ....10  
**3**—Basal joint of the hind tarsi very long.....4  
Basal joint of the hind tarsi short, much shorter than the remainder.....9  
**4**—Eyes deeply emarginate..... 5  
Eyes feebly or moderately emarginate, the notch sometimes almost obsolete...6  
**5**—Head deeply sinuate at base; antennæ thick and subcylindrical, the second joint obliquely truncate; vestiture short, matted and duplex...**Elonus**  
Head truncate at base; vestiture long, stiff and simple.  
Antennæ inserted within the eye on the emarginating canthus, strongly flabellate in the male, not observed in the female.....**Emelinus**  
Antennæ simple in both sexes, inserted just without the eyes, which are generally not quite so large.....**Zonantes**  
**6**—Prothorax not prominent at the sides; eyes more or less coarsely faceted as usual.....7  
Prothorax angulate and prominent at the sides anteriorly.....8  
**7**—Second and third antennal joints small.....**Phomalus**  
Third antennal joint elongate.

Prothorax as wide as the head; last antennal joint abruptly enlarged.

**Ariotus**

---

\* In general neatness of appearance, diversity of structure and individual rarity the *Xylophilinæ* may be fancied to bear much the same general relation to the other *Anthicidæ* that the *Eucneminaæ* bear to the rest of the *Elatridæ*, and the weights of the two subfamilies, with regard to the remainder of their respective families, are about equal. The ratio of species to genera among our representatives of *Xylophilinæ* is at present nearly 3, while among the *Eucneminaæ* it is only about 2.5, and even in the *Cerambycidæ* it is not quite 3.5. The absolute value of the generic differences I hold to be about equal in the three cases.



Prothorax narrower than the head.

Body stout as in *Zonantes*, black with pale spots.....**Pseudariotus**

Body elongate as in *Ariotus*, black or piceous, without spots.

Antennæ gradually and generally feebly incrassate.....**Vanonus**

Antennæ terminating in an abrupt parallel and five-jointed club.

**Tanilotes**

**8**—Eyes finely faceted; body minutely, densely pruinose.....**Scanylus**

**9**—Eyes coarsely faceted and completely unemarginate.....**Cnopus**

**10**—Suture between the first two amalgamated segments of the abdomen distinct throughout the width; two basal joints of the antennæ smaller, subequal and stouter than the following.

Epistomal suture fine but distinct; body stout, the antennæ short; prothorax wider than the head.....**Ganascus**

Epistomal suture completely obsolete; antennæ very long, filiform and cylindrical; prothorax narrower than the head.....**Sandytes**

**11**—Epistomal suture distinct; body stout, oval; head not constricted at base; antennæ with the first two joints stout, the remainder very slender, conspicuously ciliate, slightly incrassate near the apex.....**Axylophilus**

#### **ELONUS** n. gen.

In this genus the body is oblong, moderately convex, opaque, coarsely, densely sculptured and clothed with short confused pubescence intermixed with longer and more erect hairs. The head is deeply constricted and strongly sinuate at base, the fourth joint of the maxillary palpi moderately large and in the form of a right-angled triangle, and the last joint of the labial very large, slightly transverse, suboval, truncate at apex and deeply concave, with the surface minutely granulose and sensitive beneath. The eyes are large, deeply emarginate, coarsely faceted, conspicuously pilose and distant from the base; antennæ long, more or less thick, cylindrical and roughly sculptured, with the second joint transverse, short, as wide as the first but wider than the third and obliquely truncate at base, the last joint obliquely pointed or bent.

The middle coxæ are well separated, the posterior subcontiguous, the basal process of the abdomen rather acute, the basal segment of the latter having the dividing suture visible in the middle very near the base and almost tangent to the acetabula. The posterior tibiæ are devoid of terminal spurs, but have instead a terminal tuft of yellow setæ externally; the basal joint of the hind tarsi is extremely long, bent toward base and finely subcarinate beneath.

The male sexual characters are extraordinarily developed, and affect principally the entire surface of the abdomen and the posterior legs. The basal segment of the abdomen is impressed and more densely pubescent near each side of the body, apparently in both sexes. The pronotum is evenly convex, not at all impressed at any point, and is narrowed in front. The epistomal suture is very coarse and deep. The three species known to me may be recognized as follows:—

Short pubescence of the elytra not forming a median fascia but more or less condensed along the suture.

Front very densely punctate and granulose; epistoma densely pubescent; eyes separated by their own width; body large and stout...1. **princeps**

Front sparsely punctate and with scattered minute, acutely elevated granules; epistoma smooth, with a few remote and feeble granules; eyes much more approximate on the vertex, separated by scarcely three-fourths of their own width; body smaller and narrower.....2. **basalis**

Short and pale pubescence forming a faint zigzag median fascia and an apical spot; last antennal joint elongate and bent, at least in the male; eyes still more narrowly separated.....3. **nebulosus**

The elytral punctures in this genus are not only coarse but very deep, and their floors are flat and highly polished.

1. **E. princeps** n. sp.—Oblong, convex, dull, brownish-black throughout, the tarsi, palpi and base of the elytra, more broadly at the sides, pale testaceous; pubescence short, moderately dense, the short hairs strongly condensed along the elytral suture. *Head* wider than long, thick, convex, very densely punctate and granulose, the antennæ thick, fully two-fifths as long as the body, gradually incrassate from the third joint, the joints feebly obconical, separated and perfoliate, transverse toward apex, the eleventh oblique and not quite as long as the preceding two together. *Prothorax* distinctly narrower than the head, a little wider than long; sides parallel and nearly straight in basal half, then strongly convergent to the arcuate apex, which is scarcely more than two-thirds as wide as the base, the latter very feebly arcuate; disk evenly, moderately convex, densely sculptured like the head, each puncture with an attached setiferous tubercle. *Scutellum* large, triangular, narrowly truncate at apex. *Elytra* two-thirds longer than wide, not quite twice as wide as the prothorax, parallel and nearly straight throughout at the sides, broadly but evenly rounded at apex, the humeri narrowly rounded, well exposed at base; disk feebly impressed at each side of the suture throughout the length, also feebly so within the humeri, the punctures very coarse, deep and dense. *Abdomen* finely, moderately closely punctate, finely pubescent, the legs comparatively short, not very stout. Length 3.0 mm.; width 1.25 mm.

Canada (Ottawa).

The type is a female, taken at the indicated locality by "W.

H. H.", and very kindly given to me by Mr. Wickham. It is one of the largest known species of the subfamily.

2. **E. basalis** Lec.—Proc. Acad. Nat. Sci., Phila., 1855, p. 276 (Xylophilus?).

Color and sculpture as in the preceding, the basal pale space of the elytra large at the humeri, but only faintly extending across the scutellum, the latter more broadly truncate; pubescence more narrowly and indistinctly condensed along the elytral suture. Head transverse, the eyes at fully three-fourths of their own length from the base, and about as prominent as the tempora, the latter rounded; antennæ nearly one-half as long as the body, the tenth joint transverse, the eleventh short, conoidal, much shorter than the two preceding. Prothorax much narrower than the head, fully as long as wide, otherwise as in *princeps*. Elytra nearly three-fourths longer than wide, fully twice as wide as the prothorax, feebly impressed along the suture, very coarsely, deeply and densely cribrate. Length 2.8 mm.; width 1.0 mm.

Virginia and Illinois,—LeConte. This species is also represented in my cabinet by a single female, and is rather closely allied to *princeps*, differing in its narrower form, more elongate and less robust antennæ, which are more rapidly and apically incrassate, in its much less widely separated eyes, and other characters. In the male of both species the apical joint of the antennæ is probably much more elongate.

3. **E. nebulosus** Lec.—Trans. Am. Ent. Soc., 1875, p. 175 (Xylophilus).

Moderately stout, convex, opaque, black, the abdomen and elytra brown, the latter slightly paler at base; tarsi and palpi pale; pubescence moderately dense, the longer hairs of the elytra moderate in length. Head transverse, the eyes very large, more prominent than the tempora, distant from the base and separated by scarcely one-third of their own width; antennæ three-fifths as long as the body, moderately stout, feebly incrassate toward apex, the eleventh joint long, cylindrical, obtusely and obliquely pointed, bent and distinctly longer than the two preceding, the tenth fully as long as wide. Prothorax about as long as wide, only very slightly narrower than the head, narrowed in apical half, the arcuate apex scarcely more than three-fifths as wide as the base. Elytra two-thirds longer than wide, twice as wide as the prothorax, parallel, obtusely rounded at apex, broadly, feebly

impressed along the suture toward base, rather strongly and more narrowly impressed within the humeri, the impression extending somewhat obliquely to near the middle of each elytron; punctures very coarse, deep and close-set but not so dense as in *princeps*. Length 2.0–2.3 mm.; width 0.8–1.0 mm.

Pennsylvania. The two specimens before me are males, and I have not seen the female. The abdomen in the male is thrown up in a broad flat central region, involving the first three segments, the elevation gradually becoming free, porrect and laminate toward the apex, which is truncate, extending slightly over the fourth segment, the latter being deeply and transversely excavated. The hind thighs are greatly dilated, clothed on the inner face with short and extremely dense brown pubescence, with a subbasal excavation which is more finely pubescent, the hind tibiae, and the intermediate to a less degree, arcuate, becoming slightly thicker toward tip. The corneous sheath of the intromittant organ is long, slender and very finely pointed. It is probable that the female has the eyes less approximate and the terminal joint of the antennae shorter. There are few species of Coleoptera having more radical and remarkable sexual characters than this.

The surface of the head and pronotum is densely opaque, the punctures being extremely deep and closely, polygonally crowded, not intermixed with tubercles, as they are in *princeps* and *basalis*.

#### **EMELINUS** n. gen.

The two species separated under this name have the eyes large, subbasal, emarginate through about two-thirds of their length, coarsely faceted, coarsely and sparsely pilose, with the antennae inserted on the canthus, the third joint of the latter much elongated and the succeeding joints flabellate in the male. The base of the head exhibits no sign of the deep median sinus of *Elonus*, and the sculpture and vestiture of the body are quite different. The epistomal suture is much less coarse, the terminal joint of the maxillary palpi nearly similar but the last joint of the labial is auriculate, transverse, pointed within, with the edges of the deeply concave lower surface pilose. The middle coxae are more narrowly separated than in *Elonus*, and the dividing suture of the first abdominal segment is very strong throughout the width at some distance behind the coxae. The posterior tibiae are obliquely

truncate at tip, with a few stiff terminal setæ externally which scarcely have the nature of spurs; the basal joint of the tarsi is very long and slightly bent toward base. In the male the hind legs are much longer and proportionally a little stouter than the others, but there are apparently no striking abdominal or crural sexual characters. The species may be known as follows:—

Eyes separated by fully one-third of their own width.....1. **melsheimeri**  
 Eyes extremely large, subcontiguous; surface of the head and pronotum more opaque .....2. **ashmeadi**

These species are each represented in my cabinet by a single male only.

1. **E. melsheimeri** Lec.—Proc. Acad. Nat. Sci., Phila., 1855, p. 275 (Xylophilus).

Rather slender, polished, black, the abdomen and elytra pale, the latter with three uneven nubilata fasciæ of blackish; legs pale, the intermediate somewhat, and the posterior much, darker; antennæ pale, the appendages and also the eleventh joint blackish. Head finely and sparsely punctate, polished and not in the least reticulate, the punctures becoming slightly tuberculiform near the eyes; antennæ two-thirds as long as the body. Prothorax much narrower than the head, about as long as wide, the sides parallel, subparabolically rounded in apical third, broadly arcuato-truncate at base; disk strongly, somewhat closely and sub-tubercularly punctate, not impressed. Scutellum rather narrow, truncate at tip. Elytra three-fourths longer than wide, twice as wide as the prothorax, distinctly and arcuately swollen behind and a little wider than at base, evenly and not broadly rounded at apex; humeri not broadly exposed at base; disk narrowly impressed at each side of the suture, especially toward base; omoplates feeble; punctures very coarse, deep, close-set but not crowded, with the floors flat and polished. Length 1.9 mm.; width 0.7 mm.

Illinois and Pennsylvania,—LeConte. The pubescence is coarse, subdecumbent, cinereous, moderately long and sparse and somewhat conspicuous.

2. **E. ashmeadi** n. sp.—Moderately slender and convex, dull, blackish beneath, the legs and abdomen paler; upper surface dark rufo-ferruginous, the elytra paler; pronotum feebly nubilata with blackish, the elytra with three narrow blackish and uneven fasciæ, the flanks also black except toward apex;

antennæ pale throughout, except the basal joint which is piceous-black; vestiture moderate and subeven in length, subdecumbent, rather dense, very coarse and silvery in the pale elytral areas, finer and brownish in the darker spots and fasciæ. *Head* transverse, the eyes occupying virtually the entire surface as seen vertically, except a triangular median area at base, which is very densely punctate and opaque; antennæ three-fifths as long as the body. *Prothorax* much narrower than the head, scarcely as long as wide, the sides parallel and straight in basal two-thirds, then strongly oblique to the rounded apex, which is scarcely three-fifths as wide as the base; disk not impressed, very densely, subtubercularly punctate and opaque, the pubescence very coarse and silvery in a large median area toward base and also at the sides. *Elytra* nearly as in *melsheimeri*, but much more densely punctate and duller, the blackish spots and zigzag fasciæ much better defined; omoplates evident. *Abdomen* rather finely but strongly and somewhat densely punctate, the legs rather long. Length 2.1 mm.; width 0.8 mm.

Florida (St. Nicholas).

Differs greatly from *melsheimeri* in its much larger eyes, denser sculpture and more variegated pubescence. The antennæ in both of these species become discontinuous in direction from the apex of the third joint, each joint after the third to the tenth bearing a very long slender pilose internal ramus, and gradually becoming longer and thinner in form, the eleventh very much longer, constituting by itself the outermost ramus of the flabellum, and having a remarkable knob-like enlargement near its apex which is much larger and more noticeable in *ashmeadi*.

I have dedicated this interesting species to Mr. W. H. Ashmead of Washington, the well known student of parasitic Hymenoptera, to whom I am indebted for the unique type.

### **ZONANTES** n. gen.

This genus is rather closely allied to *Emelinus*, but differs in having the suture dividing the basal segment of the abdomen completely obsolete toward the middle and only feebly indicated at the sides, in the smaller and normal punctures, in the transversely parallelogramic prothorax which is subequal in width to the head, in the generally shorter, more oval and convex form of the body, and in the simple antennæ of both sexes. The eyes are large, coarsely faceted, coarsely and sparsely pilose, deeply, subangularly emarginate and generally at a slight distance from the base, the tempora being much less prominent and rectangular. The epistomal suture is rather fine, the fourth joint of the maxil-

lary palpi somewhat more than right-angled, the terminal joint of the labial nearly as in Emelinus. The antennæ are moderate in length, somewhat slender, with the third joint moderate in length, the eleventh swollen at the middle and very obliquely pointed. Tibiæ truncate, with a slender setiform internal spur at apex.

The eight species known thus far may be distinguished as follows :—

- Elytra each with a submedian spot of black and another between basal third and fourth, the two generally united at the sides.....1. **nubifer**  
 Elytra with a narrow dark median fascia widely interrupted at the suture, generally without trace of a scutellar spot; small species.  
 Median fascia very narrow and strongly oblique, usually resolved into two small spots on each elytron; head pale.....2. **signatus**  
 Median fascia wider and transverse; head blackish.....3. **subfasciatus**  
 Elytra with a broad median fascia of black, not interrupted at the suture; larger species.  
 Fascia broadly produced posteriorly along the suture for a short distance.  
 Legs pale flavo-testaceous throughout.....4. **hubbardi**  
 Legs in great part black; body stouter .....5. **schwarzi**  
 Fascia not at all produced posteriorly; antennæ pale flavo-testaceous throughout.  
 Dorsal pygidial plate of the female with four lamellate teeth on the inner surface at apex; scutellum large.....6. **fasciatus**  
 Dorsal plate with three teeth in the female; scutellum relatively small.  
 7. **tricuspis**  
 Elytra and entire body piceous-black throughout.....8. **ater**

The sexual characters are quite feeble throughout, and affect principally the hind femora and antennæ, the former being somewhat thicker in the male, but without a dense internal pad of pubescence, and the latter slightly shorter and thicker in that sex. The elytral punctures, though generally rather coarse, are always simple and impressed, and do not have the flat polished floors observed in Emelinus.

1. **Z. nubifer** Lec.—Proc. Am. Phil. Soc., XVII, 1878, p. 425 (*Xylophilus*).

Somewhat elongate, subparallel and feebly convex, the surface polished, black, the elytra pale, luteous, each bimaculate with black; femora blackish, the tibiæ and tarsi pale; antennæ pale flavo-testaceous, the basal joint blackish; vestiture rather long, even, inclined and stiff but not very dense. Head rather small, transverse, finely, not densely punctate; eyes larger than usual, sepa-

rated by scarcely more than two-fifths of their own width; antennæ slender, three-fifths as long as the body, the terminal joint about as long as the two preceding and notably stouter, obconical at base, obliquely and finely, conically pointed at apex. Prothorax slightly narrower than the head, one-fourth wider than long, the sides parallel and nearly straight, apex broadly, evenly arcuate and as wide as the base; disk not impressed, strongly and somewhat closely punctate. Elytra scarcely more than one-half longer than wide, three-fourths wider than the prothorax, parallel and nearly straight at the sides, broadly, circularly rounded at apex; humeri well exposed; disk with a broad depression extending obliquely from within each humerus to beyond the middle, gradually becoming obsolete; punctures rather coarse, deep and close-set. Length 2.1 mm.; width 0.85 mm.

Florida (Enterprise and Crescent City). The single specimen before me appears to be a male, but the hind femora are only moderately swollen and bent upward.

2. **Z. signatus** Hald.—Journ. Acad. Nat. Sci., Phila., 2, I, p. 97 (Euglenes); Lec.: Proc. Ac. Nat. Sci., Phila., 1855, p. 276 (Xylophilus).

Rather elongate and feebly convex, polished, pale testaceous throughout, each elytron with a small spot at the middle of the base, another at the middle at outer third, and another at apical third near the suture, of black, the two last probably connected to form an oblique fascia in some specimens; pubescence rather long, coarse and inclined, not dense. Head transverse, finely, not densely punctate, the eyes large, separated by about three-fourths of their own width; antennæ three-fifths as long as the body, somewhat slender, feebly incrassate near the tip, the last joint obliquely pointed. Prothorax large, parallel and straight at the sides, nearly as wide as the head and almost one-third wider than long, broadly rounded at apex; disk feebly uneven, slightly impressed along the median line, strongly and rather closely punctate. Scutellum large, truncate at apex. Elytra three-fifths longer than wide, three-fourths wider than the prothorax, parallel and nearly straight in basal two-thirds, thence gradually narrowed and rounded; humeri narrowly exposed; disk broadly, obliquely impressed from within the humeri to beyond the middle, also impressed at the suture near the apex, coarsely and closely punctate. Abdomen rather sparsely punctured. Length 1.5 mm.; width 0.6 mm.



South Carolina. The specimen described above is probably a male, but the sexual characters are very feeble, the hind femora being scarcely at all dilated. This is the smallest species of the genus, but is more allied to *nubifer* than to any other.

3. **Z. subfasciatus** Lec.—Trans. Am. Ent. Soc., 1875, p. 176 (Xylophilus).

Rather stout and convex, suboval, polished, pale flavo-testaceous throughout, except the head, which is piceous-black and a transverse interrupted submedian fascia, slightly dilated at the sides, of black; pubescence long, coarse and conspicuous. Head transverse, finely, sparsely punctate, the eyes large, separated by about three-fourths of their own width; antennæ slender, filiform, slightly incrassate near the apex, one-half as long as the body in the male, perceptibly shorter and stouter in the female. Prothorax slightly narrower than the head, parallel, fully one-third wider than long, broadly arcuate at apex; disk convex, scarcely uneven, very broadly and obsoletely impressed along the median line, strongly but not very closely punctate. Scutellum very large, broadly triangular, narrowly truncate and feebly bidentate at apex. Elytra barely one-half longer than wide, nearly twice as wide as the prothorax; sides parallel and broadly arcuate, narrowed and rounded in apical third; disk somewhat convex, more or less impressed along the suture especially near the apex, the oblique impression from the humeri subobsolete; punctures rather coarse and deep but well separated. Under surface somewhat coarsely but not densely punctate. Length 1.5–1.75 mm.; width 0.7–0.8 mm.

Rhode Island, District of Columbia and North Carolina (Asheville). This is one of the few species of the family which are at all common; it is allied somewhat to *signatus*, but differs in its more broadly oval form, subobsolete elytral impression and in coloration.

4. **Z. hubbardi** n. sp.—Somewhat narrow, convex, polished, piceous-black, the under surface pale, except the basal parts of the abdomen, which are piceous; legs pale flavo-testaceous throughout; antennæ black, piceo-testaceous toward base, the apical joint testaceous; elytra pale flavo-testaceous with a median black fascia as wide as one-fifth of the length, broadly prolonged posteriorly along the suture for a short distance; base also black except at the tips of the humeri; pubescence long, coarse, not dense but conspicuous. Head transverse, finely, not densely punctate, the eyes large, separated by

only slightly more than one-third of their width; antennæ slender, filiform, not at all incrassate, one-half as long as the body, the last joint much thicker, swollen at the middle, obliquely pointed and distinctly longer than the two preceding. *Prothorax* distinctly narrower than the head, only slightly wider than long, parallel and straight at the sides, broadly arcuate at apex, faintly impressed along the median line toward base and apex, strongly and rather closely punctured. Scutellum large, broadly triangular, narrowly truncate at tip. *Elytra* one-half longer than wide, about twice as wide as the prothorax, parallel and feebly arcuate at the sides, gradually narrowed and not very broadly rounded in apical third; disk broadly, very feebly impressed within the humeri, the impression traceable obliquely for some distance from the base; punctures strong but well separated. Length 2.1 mm.; width 0.8 mm.

District of Columbia. Hubbard and Schwarz.

The single type is a male having the slender apex of the œdeagus protruded, but the sexual characters are not very pronounced, the fourth ventral being perfectly simple, unmodified on the disk and only slightly longer than the third, the hind femora moderately inflated. It is probable that the female has the last joint of the antennæ less swollen and distorted.

5. **Z. schwarzi** n. sp.—Resembles the preceding, but differs in its broader form and shorter elytra. *Head* transverse, the eyes large; antennæ moderately thick and of the usual length. *Prothorax* transversely subquadrate, strongly punctate. *Elytra* scarcely two-fifths longer than wide, parallel and just visibly arcuate at the sides, narrowed in apical third, the apex rather narrowly rounded; intra-humeral impression extending obliquely and quite distinctly almost to the middle; punctures somewhat coarse, moderately close, becoming toward finer apex. Length 2.2 mm.; width 0.9 mm.

Florida (Biscayne Bay). Hubbard and Schwarz.

The under surface is dark brownish-rufous throughout, the elytra paler, rufo-testaceous, with a transverse median fascia of black which is more than one-third as wide as the total length, broadly produced posteriorly along the suture for a short distance; each elytron also has a small black spot at the middle of the base; the legs are black, the femora picescent at base, the tibiæ paler toward base and apex, and the tarsi pale. The pubescence is long and distinct.

This species is represented in my cabinet by a single male example.

6. **Z. fasciatus** Melsh.—Proc. Acad. Nat. Sci., Phila., III, p. 55; Lec.: 1. c., 1855, p. 276 (*Xylophilus*); Hald.: Journ. Acad., Phila., 2, I, p. 97 (*Euglenes*).

Stout, suboval, convex, polished, black, the legs, tip of abdomen, palpi and antennæ throughout pale flavo-testaceous; elytra black, with a large humeral spot on each and the apical fourth of both pale testaceous; pubescence long, rather coarse, conspicuous but not dense. Head transverse, finely, sparsely punctate; eyes somewhat large, separated by very nearly their own width; antennæ rather more than two-fifths as long as the body, moderately stout, very feebly incrassate near the apex, the tenth joint not as long as wide, eleventh rather small, much shorter than the two preceding, obliquely pointed as usual. Prothorax fully as wide as the head, transverse, parallel, the apex very broadly arcuate; disk feebly impressed along the median line, finely, sparsely punctate. Elytra two-fifths longer than wide, parallel and slightly arcuate at the sides, broadly rounded at apex; humeri somewhat widely exposed at base, rounded; disk convex, even, very feebly impressed near the base within the humeri, rather coarsely but not densely punctate, finely so toward apex. Abdomen polished, finely and not densely punctured. Hind femora rather stout. Length 2.2 mm.; width 1.0 mm.

Pennsylvania. The single specimen, which I took near Philadelphia, appears, from the small portion of the genital apparatus protruding, to be a female; the fourth ventral has a rounded deep and foraminiform central fovea, from which a stout seta projects obliquely; the fourth ventral is a little shorter than the two preceding together, broadly rounded or subtruncate at apex, and, on its inner surface, there is a row of asperities along the apical margin projecting inward; on the inner surface of the dorsal plate there are four large lamelliform teeth at the middle of the apex, also projecting inward; these, in conjunction with the asperities of the lower plate, possibly form a kind of clasping arrangement.

7. **Z. tricuspis** n. sp.—Rather stout, convex, elongate-oval, polished, black, the abdominal apex, legs, palpi and antennæ throughout pale flavo-testaceous, elytra pale testaceous, with a broad black fascia extending from basal fourth to apical third, prolonged narrowly along the suture, becoming expanded at the base; pubescence long, coarse, inclined, conspicuous though rather sparse. Head strongly transverse, evenly convex, somewhat finely, not densely punctate, the eyes moderately large, separated by their own width; antennæ about two-fifths as long as the body, subcylindrical, gradually and almost imperceptibly incrassate from the third joint to the apex, tenth as long as wide, eleventh not as long as the two preceding. Prothorax fully as wide as the head, one-third

wider than long, parallel and straight at the sides, the apex broadly arcuate; base broadly arcuato-truncate; disk feebly impressed along the median line toward base, rather finely but strongly, not densely punctate. Scutellum relatively small. *Elytra* large and long, two-thirds longer than wide, nearly twice as wide as the prothorax, parallel and broadly arcuate at the sides, gradually narrowed and not very broadly rounded in apical third; humeri widely rounded externally, well exposed at base; disk impressed at the suture near the apex, the subhumeral impression very short and feeble; punctures rather coarse but well separated, becoming gradually much smaller toward apex. *Abdomen* finely, sparsely punctured, the legs somewhat long, the posterior thighs moderately incrassate; basal joint of the hind tarsi very long and gradually bent toward base as usual. Length 2.5 mm.; width 1.15 mm.

Iowa (Iowa City). Mr. Wickham.

The two specimens serving as types are apparently females, with the fourth ventral one-half longer than the third, and having a rounded central setiferous foramen, the inner surface at apex with a series of about twelve small setiferous spicules, which are inwardly erect, the inner surface of the dorsal plate with three large lamelliform teeth at the middle of the apical margin and projecting inward.

This species is the largest of the genus, and, though allied closely in general appearance to *fasciatus*, may be distinguished by its more elongate elytra, smaller scutellum, larger size and other characters.

8. **Z. ater** Lec.—Trans. Am. Ent. Soc., 1875, p. 175 (Xylophilus).

Piceous-black throughout, shining; pubescence long and conspicuous. Elytral punctures rather coarse, strong and close-set throughout, separated by more than their own widths at basal third, denser toward base, finer and sparser toward apex. Pronotum not impressed, convex; antennæ thick, three-fourths as long as the elytra. Length 2.3 mm.; width 0.85 mm.

Texas (Waco). I am not at all sure of the generic position of this species, the above hasty notes having been taken from the unique type, which is now inaccessible. From an outline sketch made at the same time, the eyes appear to be much smaller than usual in this genus, and are at some distance from the base, and the prothorax is gradually narrowed behind from near the apex, which is also a character foreign to the other species.

#### **PHOMALUS** n. gen.

The small subequal second and third joints of the antennæ will readily distinguish the two members of this genus, and the fol-

lowing joints are somewhat stout, gradually and feebly incrassate, the eleventh rather small and obliquely obtuse. The eyes are large, very coarsely faceted, minutely and scarcely visibly setose, and with a small but distinct rounded emargination; they extend very nearly to the base, and the occiput is strongly, transversely arched and elevated; epistomal suture distinct; last joint of the maxillary palpi right-angled, of the labial moderately dilated, concave, densely spongy and also finely setose beneath. Prothorax transverse, with the sides parallel. Scutellum moderate in size, narrowly truncate and feebly bidentate at apex. Elytra ample. Middle coxæ moderately separated, the posterior widely separated by a broadly rounded abdominal projection. Legs moderately slender, the posterior femora longer and thicker, finely pubescent; tibiæ slender, without trace of terminal spurs; tarsi rather short, the basal joint much elongated. Abdomen with the basal segment very large, more than equalling the entire remainder, with scarcely a trace of the dividing suture; second distinctly longer than the third; fourth short in both sexes. Vestiture of the body very short, decumbent, dense, consisting of very minute, and longer and sparser hairs, intermingled.

This genus is quite distinct, and is the only one which occurs in both the Atlantic and Pacific coast faunal regions. The species may be known thus:—

Smaller and narrower, more opaque, the punctuation much denser; sides of the prothorax not at all prominent behind the apex...1. **brunnipennis**  
Larger and more obese, more shining, much less densely and less evenly punctate, the sides of the prothorax more angulate anteriorly.....2. **saginitus**

The sexual characters are extremely feeble throughout.

1. **P. brunnipennis** Lec.—Trans. Am. Ent. Soc., 1875, p. 176 (Xylophilus).

Moderately stout, convex, opaque, dark red-brown throughout, the head and posterior femora blackish, the pronotum piceous; pubescence short, dense, cinereous and decumbent. Head transverse, convex, broadly arcuato-truncate at base, dull, finely but strongly, rather densely punctate; eyes large and convex, separated by three-fourths of their own width or somewhat more, the tempora short, much less prominent and convergent; antennæ stout, two-fifths as long as the body, the joints feebly obconical, the first elongate-oval, penultimate joints wider than long, the

eleventh small and very much shorter than the two preceding in both sexes. Prothorax slightly narrower than the head, transverse, the sides parallel and nearly straight; apex broadly but strongly arcuate; disk convex, slightly uneven, densely and strongly punctate. Elytra two-fifths longer than wide, twice as wide as the prothorax; sides parallel and broadly arcuate; apex semi-circularly rounded; femora well exposed and rounded at base; disk not very coarsely but densely punctate, abruptly nearly vertical at the flanks, the oblique impression from the humeri feeble. Abdomen finely punctate, minutely and very densely pubescent. Length 1.7–1.75 mm; width 0.75 mm.

District of Columbia. The fourth ventral of the male is distinctly shorter than the third, broadly, evenly rounded and unmodified, the genital segment small, coriaceous and rounded; the fourth ventral of the female is fully as long as the third and is evenly rounded behind, without noticeable modification of structure.

2. **P. saginatus** n. sp.—Stout, convex, feebly shining, pale brownish-testaceous, the abdomen piceous-black; pronotum rufo-piceous; head and hind femora blackish; pubescence very short, moderately dense, decumbent. *Head* transverse, convex, somewhat closely punctate and conspicuously pubescent, the eyes separated by slightly less than their own width; antennæ stout, cylindrical, scarcely at all incrassate, rather more than two-fifths as long as the body, the basal joint as long as the next two, penultimate joints as long as wide, the eleventh almost as long as the two preceding, obliquely pointed. *Prothorax* transverse, subequal in width to the head, the sides very feebly convergent from the subapical angles to the base; apex broadly arcuate, the base less arcuate; disk convex, finely, moderately closely punctate, broadly and extremely obsoletely impressed transversely near the base. *Elytra* oval, two-fifths longer than wide, fully twice as wide as the prothorax, parallel and broadly arcuate at the sides, very obtusely rounded at apex; disk with a feeble narrow impression within the humeri not extending posteriorly, finely, strongly and moderately closely punctate. Length 1.8–2.1 mm.; width 0.9 mm.

California (near Monterey).

A specimen from Arizona is much smaller, with narrower and more oblong elytra, which are more coarsely punctate and still more polished, the punctures more impressed; it probably represents a very closely allied species and is not included in the above measurements. This species differs conspicuously from *brunnipennis* in its more robust form, more shining surface, longer antennæ and numerous other characters.

**ARIOTUS** n. gen.

The body in this genus is narrow, elongate and subparallel, the head not wider than the prothorax, with the epistomal suture distinct, the base transversely truncate and broadly arched, the eyes moderately large, rounded, subglobular, very coarsely faceted, scarcely at all setose and with only the slightest evidence of a minute emargination, the tempora very short, rounded and much less prominent. Last joint of the maxillary palpi short, very broad, the basal angle being very obtuse, of the labial moderately large, transversely subsecuriform, with the apex obliquely beveled and sensitive, differing completely from the form seen in the preceding genera. The antennæ are rather short, slender, incrassate toward apex. The prothorax is transversely and feebly obtrapezoidal, not impressed, the scutellum small, narrowly trapezoidal, and the elytra parallel and devoid of distinct impressions. The middle coxæ are narrowly separated, the posterior only slightly more widely so, the hind femora not dilated, the corresponding tibiæ devoid of terminal spurs but with a porrect terminal plate internally, apparently composed of agglutinated setæ; tarsi slightly shorter than the tibiæ. The basal segment of the abdomen is not quite as long as the remainder, without trace of dividing suture, the second and third equal, and the fourth much longer than the third.

Our two species differ decidedly and may be mutually distinguished as follows:—

- Head punctate; elytra with a terminal black area which is produced anteriorly along the suture, the short vestiture intermixed with longer and coarser hairs.....1. **quercicola**  
 Head subimpunctate; elytra without a terminal dark spot, the vestiture very fine, short and decumbent, the intermixed longer hairs sparse, short and indistinct.....2. **subtropicus**

No sexual characters are observable, and the sex of the individuals thus far taken has not been determined. The genus is confined, as far as known, to the Florida peninsula.

1. **A. quercicola** Schz.—Proc. Am. Phil. Soc., XVII, 1878, p. 371 (Xylophilus).

Narrow, parallel, moderately convex, rather dull, pale flavo-testaceous, the under surface and head slightly dusky; legs and antennæ pale throughout, except the large terminal joint of the

latter, which is blackish; pubescence very short, decumbent and somewhat dense, the coarse suberect hairs sparser. Head transverse, convex, rather coarsely, deeply but sparsely punctate, the median line impunctate; eyes moderate, separated by fully twice their own width; antennæ two-fifths as long as the body, the basal joint moderately long and thicker than the second, third very narrow, three to ten gradually and very distinctly increasing in width, eleventh abruptly much thicker than the preceding and rather longer than the ninth and tenth together. Prothorax transverse, the sides feebly divergent from base to apex and nearly straight; apex broadly arcuate; disk evenly convex, somewhat finely but deeply, moderately densely punctate. Elytra three-fourths longer than wide, about three-fourths wider than the prothorax, parallel and very feebly arcuate at the sides; apex evenly, circularly rounded; humeri rounded and rather narrowly exposed; disk scarcely perceptibly impressed within the humeri, somewhat coarsely, strongly but sparsely punctate, the punctures gradually becoming almost completely obsolete at apex. Basal segment of the abdomen finely, sparsely punctate, the remainder not visibly punctured. Length 1.7 mm.; width 0.55 mm.

Florida (Tampa and Hillsboro). The elytra have a transversely parallelogramic basal spot, a median fascia which is broadly interrupted at the suture, and an apical spot, produced along the suture to apical third, of black.

2. **A. subtropicus** n. sp.—Narrowly suboval, rather convex and somewhat dull, pale flavo-testaceous throughout, the antennæ gradually slightly dusky toward apex; head piceous-black; elytra with an extremely feeble and nubilate dark area at base, and a stronger but nubilate fascia just behind the middle, narrowly and imperfectly interrupted at the suture, and not quite attaining the lateral margins; pubescence extremely short, dense and rather coarse, cinereous, the longer hairs decumbent, sparse and imperceptible except under high power. Head transverse, convex, finely pubescent, impunctate, except a few punctures along the transverse crest of the occiput and very near the eyes, the latter somewhat large and convex, separated by about one-half more than their own width; antennæ slightly longer than the head and prothorax, rather slender, gradually and moderately incrassate, the last joint slightly broader but much shorter than the two preceding together. Prothorax about as wide as the head, transversely obtrapezoidal, the apex broadly, circularly arcuate, the sides nearly straight; disk evenly convex, finely and not densely punctate, the punctures somewhat obscured by the vestiture. Elytra three-fifths longer than wide, not quite twice as wide as the prothorax, perceptibly wider in the middle than at base, the sides parallel and distinctly



arcuate; apex circularly rounded; humeri rounded and rather narrowly exposed at base; disk convex, the intra-humeral impression very feeble and basal; punctures not very coarse but distinct, rather sparse, becoming gradually obsolete at apex. *Legs* moderate in length, somewhat slender, the hind femora not at all inflated. Length 1.65 mm.; width 0.6 mm.

Florida (Tampa). Hubbard and Schwarz.

The fourth ventral, in the single type before me, is about one-half longer than the third and circularly rounded. This species differs from *quercicola* in its broader and more oval form and much larger eyes, in addition to the characters of the table.

#### **PSEUDARIOTUS** n. gen.

The rather minute species separated under this name have a short obese and convex form of body, polished elytra, and a vestiture which is suberect and composed of hairs which differ distinctly in length and which are confusedly intermingled. The head is only very slightly wider than the prothorax, the eyes somewhat large, convex, extending to within an extremely short distance of the base, rather finely faceted and with a small but distinct anterior notch; they are distinctly and rather densely pilose. Epistomal suture distinct. Last joint of the maxillary palpi moderately large, right-angled, that of the labial unusually developed, short but extremely transverse, with the subtruncate apex concave and spongy, differing noticeably in form from any of the previous genera, but resembling somewhat that of *Sandytes*. Antennæ slender, gradually and feebly incrassate, moderate in length, pilose. Prothorax feebly constricted at the sides of the apex, the disk somewhat uneven, transversely and slightly tumid behind the middle and tumid near the sides at apical and basal third. Scutellum broadly triangular, subtruncate at tip. Basal segment of the abdomen distinctly shorter than the remainder, with the dividing suture only slightly indicated near the sides of the body, the succeeding segments subequal among themselves. The elytra are black, ornamented with pale spots.

The two species known to me may be distinguished as follows:—

|  |                   |
|--|-------------------|
| Pronotum opaque, posterior pale spots of the elytra situated just behind the middle..... | 1. <b>notatus</b> |
| Pronotum polished; posterior pale spots at apical fourth.....                            | 2. <b>amicus</b>  |

Nothing is known concerning the sexual characters, which are probably very slight.

1. **P. notatus** Lec.—Proc. Acad. Nat. Sci., Phila., 1855 p. 276 (Xylophilus).

The unique type of this species is not before me at present, but from a sketch made some years ago, the posterior pale spot of the elytra is situated at about apical third; this, in conjunction with LeConte's statement "capite thoraceque opacis, confertim punctulatis," and the fact that the type was taken in Habersham County, in the extreme northeastern and submountainous parts of Georgia, a region zoölogically altogether distinct from the tropical southern tip of Florida, leads me to believe that *notatus* will prove to be quite distinct from *amicus*. The generic diagnosis is taken from the latter. The type of *notatus* is 1.4 mm. in length; width 0.65 mm.

2. **P. amicus** n. sp.—Oval, convex, polished, rufo-piceous, the legs and antennæ pale flavate; elytra black, gradually pale toward apex, each with a large irregular and transversely reniform spot at basal fourth, extending at the sides to the humeri, and another large subquadrate spot at apical fourth, of pale flavo-testaceous; pubescence moderately long, rather close, coarse and distinct. Head feebly convex, shining, subimpunctate; eyes separated by about one-half more than their own width; antennæ barely two-fifths as long as the body, gradually incrassate through the six or seven outer joints, third and fourth equal and very slender, eleventh moderately large, compressed, obliquely and abruptly pointed. Prothorax slightly narrower than the head, transverse, fully one-third wider than long, the sides gradually and very feebly convergent from near the apex to the base, the latter margined throughout the width with an extremely fine elevated bead; apex broadly, feebly arcuate; disk rather finely but strongly, moderately closely punctate. Elytra about one-third longer than wide, nearly twice as wide as the prothorax, parallel and broadly arcuate at the sides, semi-circularly rounded at apex; humeri rounded but somewhat widely exposed at base; disk not evidently impressed near the humeri, convex, not coarsely but strongly, rather sparsely punctate, the punctures becoming very fine and relatively remote toward apex. Abdomen convex, shining, the legs slender. Length 1.3 mm.; width 0.65 mm.

Florida (Biscayne Bay). Hubbard and Schwarz.

The type, which is one of two specimens, is a female and is somewhat mutilated.

### **VANONUS** n. gen.

The body in *Vanonus* is moderately elongate and subparallel, clothed with very short decumbent pubescence, the head transversely truncate and moderately elevated at base, with the eyes variable but always semi-nude, the setæ being extremely minute; they

are minutely and feebly emarginate and generally moderately coarsely faceted, the facets in one group becoming extremely large, however. The epistomal suture is distinct and the epistoma simple at apex, except in *wickhami*, where it becomes finely beaded. Last joint of the maxillary palpi large, extremely dilated, bent transversely on its compressed side in the form of a bow, with the basal angle broadly obtuse, that of the labial moderate in size, thick, the apex truncate in the form of a flat circular or inwardly pointed disk, which is densely pubescent and sensitive. Antennæ moderate in length and thickness, gradually and generally feebly incrassate, the third joint much longer than the fourth, the second small, eleventh moderate in size, conoidal and normal. The middle coxæ are well separated, the posterior still more widely, the posterior femora not noticeably dilated but having beneath in both sexes an elongate area, clothed with dense erect and papillose pubescence; tibiæ narrowed toward base, the internal terminal spurs extremely minute and setiform, sometimes apparently obsolete; tarsi moderately long, very slender, the basal joint greatly elongate. Abdomen with the basal segment very large, without trace of dividing suture, the fourth much longer than the third. Prothorax narrowed in front, generally transversely impressed on the disk near the base. Scutellum small, narrowly trapezoidal. Elytra oblong-oval, the flanks rather abruptly vertical. Sexual characters not determined and apparently extremely feeble.

The species in my cabinet may be separated into four groups, as shown by the following table:—

Eyes extending virtually to the base of the head, the tempora extremely short.

Eyes moderate in size and coarseness of granulation, the antennæ widely separated at base.

Elytra clothed sparsely with very short, coarse and decumbent hairs. (I)

**1. calvescens**

Elytra rather densely clothed with short fine pubescence, the hairs all similar and of equal length; transverse subbasal impression of the pronotum distinct and uninterrupted. (II)

Eyes separated by fully twice their own width, the vertex flatter and densely punctate.

Larger species, the transverse impression of the pronotum feeble in profile and very near the base .....2. **piceus**

Smaller, the transverse impression deeper and larger in profile, occupying more than basal third; elytral omoplates rather smaller and more pronounced.....3. **tuberculifer**

Eyes much less distant, separated by about one-half more than their own width; vertex convex, more shining, very minutely and sparsely punctate; body very small and narrow.....4. **vigilans**

Eyes large, convex and very coarsely faceted; antennæ much more approximate in insertion; elytra very densely clothed with extremely minute appressed pubescence giving a strongly opaque or pruinose effect, the punctures bearing each a longer stiffer hair, which is however still minute and subdecumbent; subbasal impressions of the pronotum feeble and completely separated. (III)

Antennæ filiform, just visibly and evenly incrassate throughout the length.

Antennæ decidedly thick; basal impressions of the pronotum large and distinct.....5. **huronicus**

Antennæ slender; basal impressions almost completely obsolete.

#### 6. **sagax**

Antennæ much shorter, rapidly and strongly incrassate toward apex, the penultimate joints strongly transverse; basal impressions of the pronotum feeble.....7. **floridanus**

Eyes smaller and only moderately coarsely faceted, the tempora relatively long, parallel and distinct behind them; antennæ longer, inserted at some distance from the eyes and moderately separated at base; impressions of the pronotum and vestiture nearly as in the *piceus* group. (IV) 8. **wickhami**

All but one of these species are represented before me by a single specimen, and the extent of the genus will be greatly increased by future collecting. These species are, however, widely distinct among themselves, and the limited number of examples is, for this reason, a matter of but little consequence.

1. **V. calvescens** n. sp.—Oblong-elongate, feebly convex, moderately shining, blackish-castaneous throughout; vestiture extremely short, sparse and rather coarse, closely decumbent. *Head* strongly transverse, finely reticulate, more obsoletely toward the median line, finely, strongly, not densely punctate, the eyes large, globular, separated by three-fourths more than their own width; antennæ somewhat stout, feebly and gradually incrassate throughout, about one-third as long as the body, the tenth joint slightly transverse, the eleventh conoidal, not as long as the two preceding. *Prothorax* distinctly narrower than the head, obliquely narrowed in apical third, about one-fourth wider than long; apex arcuate and much narrower than the base; disk feebly convex, polished, not reticulate, rather finely, deeply but not densely punctate, broadly, feebly impressed transversely near the base, the impression continuous. *Scutellum* as wide as long, trapezoidal, rather tumid. *Elytra* fully three-fourths longer than wide, twice as wide as the prothorax, parallel and very feebly arcuate at the sides; apex broadly and obtusely rounded; humeri broadly rounded to the prothorax; disk with a large impression at basal third, extending obliquely within the humeri, also impressed on each side of the suture behind the scutellum, and feebly at apical fifth, the omoplates large;

punctures not very large but deep, rather sparse, becoming gradually very fine and sparse toward apex, surface alutaceous, reticulate, the fine lines radiating from each puncture, the sculpture effaced near the suture. *Legs* moderate in length, slender. Length 2.4 mm.; width 0.85 mm.

Wisconsin (northeastern).

The largest species of the genus, being nearly twice as large as the next in size, but possessing all the generic features of *Vanonus*. It will be readily identifiable by its size, sculpture and vestiture.

2. **V. piceus** Lec.—Proc. Acad. Nat. Sci., Phila., 1855, p. 276 (*Xylophilus*).

Moderately stout, black, with the legs and antennæ more or less dark red-brown; body sometimes paler, with the head always dark; integuments shining; pubescence very minute, close and evenly decumbent. Head transverse, finely, strongly and rather densely punctate, the eyes separated by fully twice their own width; antennæ two-fifths as long as the body, gradually and quite perceptibly incrassate, the tenth joint slightly transverse. Prothorax distinctly narrower than the head, only slightly wider than long, parallel, narrowed anteriorly, the apex arcuate and distinctly narrower than the base; disk convex, very finely, densely punctate, the subbasal impression bisinuate along its posterior margin. Elytra scarcely three-fifths longer than wide, twice as wide as the prothorax, parallel and feebly arcuate at the sides except near the base, broadly rounded behind, feebly impressed near the base and within the humeri, the omoplates moderately large and prominent; punctures somewhat fine, moderately close-set toward base, minute and more distant behind. Abdomen minutely punctate and pubescent. Length 1.65 mm.; width 0.65 mm.

Pennsylvania, New York and Wisconsin (Bayfield). A single specimen from each locality.

3. **V. tuberculifer** Ham.—Can. Ent., XXIV, 1892, p. 279 (*"Xylophilus"*).

Similar to the preceding but much smaller, black, the antennæ paler; integuments polished; pubescence minute, decumbent, even and moderately dense. Head transverse, the vertex flat or feebly concave, finely punctate, the punctures separated by about twice their own diameters; eyes moderate, separated by rather

more than twice their own width; occiput descending subvertically to the neck in profile; antennæ missing. Prothorax small, distinctly narrower than the head, only slightly wider than long, narrowed and very feebly arcuate at apex, finely, densely punctate, the basal impression broad, deep and nearly straight. Elytra oblong, three-fifths longer than wide, rather more than twice as wide as the prothorax, distinctly impressed near the base and within the humeri, the omoplates small and prominent; punctures small but deep and clearly defined on the polished surface, moderately close-set. Legs missing. Length 1.4 mm.; width 0.6 mm.

Ontario (Severn). The original description of Dr. Hamilton is altogether insufficient, and I am somewhat doubtful of the reference, as the medium of publication omits signature marks. The specimen before me lacks the head and all the legs, and is one of the two original types recently sent to me by the author; the above description of the head is from pencil notes and diagrams taken from the best preserved of the types. This species is somewhat closely allied to *piceus*, but is evidently distinct.

4. **V. vigilans** n. sp.—Narrow, moderately convex, dark piceo-castaneous, the legs and antennæ but slightly paler; head blacker; vestiture minute and dense. *Head* transverse, rather convex, polished, minutely and somewhat sparsely punctate, the punctures elongate and with their axes oblique to the median line; eyes large, convex, separated by one-half more than their own width; antennæ rather thick, densely pilose, scarcely two-fifths as long as the body, gradually and feebly incrassate, the tenth joint about as long as wide. *Prothorax* distinctly narrower than the head, only slightly wider than long, parallel, narrowed and broadly arcuate at apex, minutely, densely punctate, the basal impression deep, transverse, shallower in the middle but perfectly continuous. *Elytra* three-fifths longer than wide, barely twice as wide as the prothorax, parallel and broadly arcuate at the sides, becoming straight near the base, broadly, obtusely rounded at apex; humeri rounded, moderately exposed at base; disk broadly impressed near the base and thence narrowly and obliquely within the humeri; omoplates rather small and moderately prominent; punctures fine but strong, dense and almost equal from base to apex. *Abdomen* finely but somewhat sparsely punctate, minutely pubescent. Length 1.3 mm.; width 0.55 mm.

New York. Mr. H. H. Smith.

This species is allied to the preceding, but differs conspicuously in its narrow and more convex form of body, denser punctation and vestiture, much larger eyes, different sculpture and convexity of the vertex and in several other characters.

5. **V. huronicus** n. sp.—Oblong, convex, black; tibiae, tarsi and antennae pale testaceous; integuments dull, the entire surface minutely, densely punctulate, these punctures bearing the minute hairs; vestiture very dense. *Head* transverse, convex, the distinct punctures only present toward base; eyes large, globular, separated by barely their own width; antennae just visibly incrassate, densely pilose, nearly one-half as long as the body, the tenth joint but slightly wider than long. *Prothorax* much narrower than the head, slightly wider than long, convex, parallel, narrowed and transversely rounded at apex, minutely and extremely densely punctate and pubescent, the basal impressions large, distinct and completely separated at the middle. *Elytra* three-fifths longer than wide, twice as wide as the prothorax, parallel and very feebly arcuate throughout at the sides, obtusely rounded at apex; humeri rounded to the prothorax and moderately exposed at base; disk feebly impressed behind the omoplates, also narrowly and obsoletely within the humeri, the omoplates large and very feeble; surface rather finely but deeply and closely punctate, the punctures well separated and becoming gradually a little finer behind. *Abdomen* finely, sparsely punctate, minutely, very densely punctulate, dull and minutely, densely pubescent, the basal segment fully as long as the entire remainder. *Legs* slender throughout. Length 1.4 mm.; width 0.6 mm.

Michigan.

The type is a male but has no distinct sexual characters, the extremity of the intromittent organ being very slender and perfectly simple; the fourth ventral is about two-thirds longer than the third, and is evenly and somewhat narrowly rounded.

6. **V. sagax** n. sp.—Narrowly oblong, moderately convex, black, the legs testaceous, with the intermediate femora slightly, the posterior deeply, blackish; antennae pale testaceous throughout; integuments dull, extremely minutely, densely punctulate, also with coarse punctures; pubescence short, minute and very dense. *Head* transverse, finely but strongly, densely punctate throughout to the apex; eyes large and globular, separated by a little less than their own width; antennae slender, nearly one-half as long as the body, gradually and just visibly incrassate throughout, the tenth joint fully as long as wide. *Prothorax* much narrower than the head, distinctly wider than long, parallel, strongly, obliquely narrowed in apical third, the apex distinctly arcuate and much narrower than the base; disk somewhat convex, finely, very densely punctate, obsoletely biimpressed near the base. *Elytra* two-thirds longer than wide, not more than three-fourths wider than the prothorax, semi-circularly rounded behind, parallel and very feebly arcuate at the sides; humeri rounded to the prothorax and narrowly exposed at base; disk impressed within the humeri, and thence obliquely and posteriorly toward the suture, abruptly declivous and obliquely subprominent laterally toward base, strongly and densely punctate toward base, gradually finely so toward apex; omoplates feeble. *Abdomen* densely punctulate, finely, sparsely punctate, the punctures greatly elongate in form, the legs slender. Length 1.3 mm.; width 0.5 mm.

Florida (Indian River).

A minute and narrow species, with globose and very coarsely faceted eyes and opaque, pruinose integuments; it is readily distinguishable from *huronius* by the characters of the table, and by its entirely punctate head.

7. **V. floridanus** n. sp.—Oblong, moderately stout and convex, brownish-black, the abdomen rufescent; legs testaceous, the hind femora slightly darker and brownish; antennæ pale testaceous; integuments dull and pruinose, the vestiture short and very dense, with sculpture as in the preceding two species. *Head* transverse, finely, densely punctate throughout, but obsoletely so toward the epistoma; vertex rather wide and flat between the eyes, which are separated by about one-fourth more than their own width; antennæ short, scarcely one-third as long as the body, rapidly and evenly incrassate from the sixth joint, joints eight to ten strongly transverse, the eleventh but slightly longer than wide, simple and conically pointed. *Prothorax* distinctly narrower than the head, transverse, nearly one-third wider than long, parallel and rounded at the sides, narrowed and transversely arcuate at apex, finely, very densely punctate; subbasal impressions large, feeble and widely separated. Scutellum transversely trapezoidal, widely truncate at apex, the angles subprominent as usual. *Elytra* three-fifths longer than wide, not quite twice as wide as the prothorax, parallel and feebly arcuate at the sides, obtusely rounded at apex, the humeri rounded to the prothorax and rather well exposed at base; disk obliquely impressed from within the humeri, and also behind the scutellum, somewhat finely but strongly, densely punctate, the omoplates rather small and somewhat prominent. *Abdomen* with fine, sparse and elongate punctures, in addition to the minute punctulation, the legs slender. Length 1.45 mm.; width 0.6 mm.

Florida (Crescent City). Hubbard and Schwarz.

This species differs greatly from the two preceding in its short, gradually claviform antennæ, and more widely separated eyes.

8. **V. wickhami** n. sp.—Oblong, moderately convex, black; antennæ and legs black throughout, except the second and eleventh joints of the former, which are slightly paler; integuments somewhat shining, the pubescence fine, even, moderately dense as in *piceus*. *Head* strongly transverse, finely, densely punctate throughout, the vertex broad and convex, the eyes relatively small, separated by twice their own width, the tempora behind them parallel, three-fourths as long and nearly as prominent; antennæ long, slender, about one-half as long as the body, the tenth joint nearly as long as wide, the eleventh oval, pointed, about as long as the two preceding. *Prothorax* slightly narrower than the head, distinctly wider than long, only slightly narrowed and broadly arcuate at apex, the latter about four-fifths as wide as the base; sides parallel, feebly arcuate; disk convex, finely, rather strongly and very densely punctate, the subbasal impression large, deep and continuous, its pos-



terior margin nearly straight. *Elytra* nearly three-fourths longer than wide, twice as wide as the prothorax, the sides parallel, feebly arcuate, becoming straight near the base; apex almost evenly rounded; humeri narrowly rounded, somewhat broadly exposed at base; disk scarcely at all impressed except behind the scutellum, finely, densely punctate, the omoplates small and rather feeble. *Abdomen* finely, somewhat sparsely punctate, the punctures slightly elongate, finely pubescent, the first segment rather longer than the remainder, the fourth about as long as the two preceding. *Legs* rather long and slender. Length 1.6 mm.; width 0.65 mm.

Wisconsin (Bayfield). Mr. H. F. Wickham.

A small but very distinct species to be readily known by its smaller eyes, longer tempora, longer antennæ and completely black legs. It is much more closely allied to *piceus* than to the *huronius* group, and is placed at the end of the genus solely for taxonomic reasons.

#### **TANILOTES** n. gen.

The members of this genus greatly resemble *Vanonus* in general form and habitus, and the sculpture and fine, even, decumbent vestiture are exactly as in the *piceus* group of that genus. The head is only very slightly wider than the prothorax, the eyes moderate in size, coarsely faceted, with very short setæ, which are much more evident in *densus* than in *lacustris*, rather distant from the base and minutely, feebly emarginate anteriorly. Epistomal suture distinct, the epistoma narrowly coriaceous at apex, and apparently with an adjacent terminal beaded segment which, however, may be a basal margin of the labrum. Palpi as in *Vanonus*. Antennæ somewhat short, abruptly clavate, the club parallel and five-jointed. Pronotum biimpressed near the base. Scutellum moderate, trapezoidal. Middle coxæ moderately separated, the posterior not more widely so. Abdomen with the basal segment large, much more than equaling all the others combined, the fourth varying in length, the first three segments margined at apex with a very wide pale and coriaceous border. Legs slender, the hind femora completely devoid of the papillose pad of *Vanonus*, but having beneath near the apex, and in both sexes, a large lamelliform tooth.

Our two species mutually differ to a great degree, but are perfectly congeneric, as shown by the capitate antennæ and toothed hind femora; they may be known as follows:—

Eyes much larger, separated by scarcely one-fourth more than their own width, the setæ distinct and recurved; terminal segment of the abdomen nearly as long as the two preceding; femoral tooth strongly bent, the concavity within; size much larger.....1. **densus**

Eyes small, separated by three times their own width and very feebly setose; terminal segment only slightly longer than the third; femoral tooth erect; size minute.....2. **lacustris**

The sexual characters are not distinct, as far as can be observed.

1. **T. densus** Csy.—Cont. Col. N. A., II, 1885, p. 187 (Xylophilus).

Oblong, moderately convex, brownish-black throughout; antennæ dark red-brown; tibiæ brown, the tarsi testaceous; integuments densely punctate, the narrow interspaces polished and minutely punctulate; vestiture very short, dense, decumbent and in a single system. Head transverse, rather convex, finely and not very densely punctate throughout, the punctures perforate, oval and with their axes directed obliquely to the median line; tempora about one-third as long as the eyes, measured longitudinally, and much less prominent; antennæ stout, one-third as long as the body, joints seven to ten strongly transverse. Prothorax only slightly narrower than the head, transverse, convex, very densely punctate, with two widely separated subbasal impressions. Elytra fully three-fourths longer than wide, two-thirds wider than the prothorax, parallel and very feebly, evenly arcuate at the sides; humeri rounded to the prothorax and rather widely exposed at base; disk finely but strongly, very densely punctate; omoplates somewhat large, approximate and distinct. Length 2.0 mm.; width 0.75 mm.

Pennsylvania (near Philadelphia). The unique type is the only specimen known to me, and is of undetermined sex.

2. **T. lacustris** n. sp.—Oblong, somewhat convex, black throughout, the basal joints of the antennæ and tip of the eleventh, paler and testaceous; integuments very densely punctate, the interspaces polished and not distinctly punctulate, the pubescence very short and single. Head transverse, rather convex, polished, finely, not very densely punctate; eyes rather small, moderately convex, at nearly their own length from the base, the tempora parallel and only slightly less prominent; antennæ not quite two-fifths as long as the body, moderately slender, joints seven to ten perceptibly wider than long. Prothorax only slightly, though distinctly, narrower than the head, one-fourth wider than long, feebly narrowed in front, the apex transversely and feebly arcuate; sides feebly arcuate; disk convex, extremely densely, finely punctate, with two large and deep subbasal impressions, which are somewhat approxi-

mate and not altogether disconnected. *Elytra* two-thirds longer than wide, twice as wide as the prothorax, gradually and arcuately narrowed in apical third, the apex transversely rounded; sides feebly arcuate, becoming straight and parallel near the base; humeri rounded, well exposed at base; disk finely but strongly, very closely punctate; omoplates approximate and moderately strong. *Abdomen* finely but not densely punctate, rather densely clothed with recumbent pubescence, the basal segment very much larger than the entire remainder. *Legs* moderate in length, slender. Length 1.6 mm.; width 0.6 mm.

Wisconsin ( Bayfield ). Mr. Wickham.

A very small but interesting species, which may be identified at once by the capitate antennæ, small and widely separated eyes and toothed femora. A single female.

#### SCANYLUS n. gen.

Body anthiciform, pruinose, with extremely dense short fine and decumbent pubescence, unmixed with longer hairs. Head not wider than the prothorax, the eyes rather large, finely faceted, with short recurved setæ and a small but distinct anterior emargination. Epistomal suture distinct. Antennæ moderately long, gradually and perceptibly incrassate from the third joint, the latter slender. Last joint of the maxillary palpi right-angled, of the labial tumid, with the obliquely truncate apex transversely oval, deeply concave and feebly pilose. Prothorax tumid and prominent at the sides anteriorly, transversely and feebly impressed dorsally near the base, the apex with a distinct marginal bead which is possibly homologous with the collar in *Anthicus*. *Elytra* with widely exposed humeri. Middle and hind coxæ slightly separated. Abdomen with the basal segment not as long as the remainder, the dividing suture fine and distinct, becoming obsolete only in the middle; last three segments equal in length among themselves. Legs slender, the hind femora not at all dilated and perfectly simple beneath; tibiæ simple; tarsi very slender, moderately long, the basal joint almost twice as long as the remainder.

The above description is drawn from *pruinusus*, the generic type, and *luteolus* differs in having the eyes slightly less finely faceted, the hind femur provided beneath with a dense comb of erect fulvous bristles almost throughout its entire extent, the humeri much less exposed, the antennæ filiform, and the pronotum

devoid of the apical beaded edge; the two species may, however, be considered congeneric for the present and can be distinguished as follows:—

Large, the elytra broad, finely and sparsely punctate toward base; color black, the prothorax dark red-brown.....1. **pruinus**  
 Small and narrow, pale testaceous throughout, the elytra strongly and densely punctate toward base.....2. **luteolus**

These species represent one of the most distinct generic types of the subfamily, because of the finely faceted eyes.

1. **S. pruinus** n. sp.—Rather broad and depressed, black throughout, the legs, antennæ and prothorax dark rufo-testaceous; integuments alutaceous, densely and very minutely punctulate throughout, also visibly punctate, the larger punctures not bearing longer hairs; pubescence very minute, extremely dense and decumbent, giving a densely pruinose effect. *Head* transverse, convex, finely, rather sparsely punctate; eyes separated by one-half more than their own width; tempora rounded, one-half as long as the eyes and a little less prominent; antennæ two-fifths as long as the body, gradually and distinctly incrassate, the third joint slender and longer than the fourth, tenth as long as wide, eleventh conoidal, obliquely pointed, not as long as the two preceding. *Prothorax* as wide as the head, slightly wider than long, prominent and subtuberculate at the sides at apical two-fifths, the sides thence strongly oblique and straight to the apex which is transversely truncate and two-thirds as wide as the base, feebly convergent toward base; disk feebly convex, finely, sparsely punctate, very obsoletely, transversely impressed near the base. Scutellum trapezoidal, wider than long, the angles somewhat prominent. *Elytra* broad, two-thirds longer than wide, twice as wide as the prothorax, parallel and feebly arcuate at the sides, broadly rounded at apex; humeri rounded, rather widely exposed at base; disk somewhat flat, the omoplates feeble; punctures fine and sparse toward base, becoming gradually subobsolete behind the middle. *Abdomen* alutaceous, finely, densely pubescent, with a few small and scattered punctures in the middle near the base. *Legs* moderately long, slender. Length 2.8 mm.; width 1.0 mm.

Arizona (Williams).

This species is relatively large for the present subfamily, and greatly resembles an *Anthicus*, to such an extent in fact that it was sent to me as a representative of that genus. The sex of the unique individual is not determinable.

2. **S. luteolus** n. sp.—Narrow and somewhat convex, pale rufo-testaceous throughout, the elytra more flavate and the hind femora slightly brownish; integuments alutaceous, the minute punctules bearing the extremely fine decumbent pubescence not visible, being entirely occupied by the bases of the hairs; larger punctures rather dense and distinct. *Head* transverse, convex, finely, somewhat sparsely punctate toward base; eyes prominent, sepa-

rated by two-thirds more than their own width, the tempora one-half as long, parallel and much less prominent; basal angles rather narrowly rounded, base broadly sinuato-truncate; antennæ long, filiform, slender, not at all incrassate, rather more than one-half as long as the body, third joint elongate, longer than the fourth, tenth distinctly longer than wide, eleventh narrowly oval, somewhat obliquely pointed, a little thicker than the tenth, much shorter than the two preceding. *Prothorax* subequal in width to the head, a little wider than long, prominent laterally at apical third, the sides thence very oblique and nearly straight to the apex, which is broadly arcuato-truncate and three-fourths as wide as the base, very feebly convergent to the base; disk feebly convex, nearly even, not distinctly impressed, finely but strongly, very closely punctate. Scutellum narrowly trapezoidal. *Elytra* three-fourths longer than wide, four-fifths wider than the prothorax, parallel and very feebly arcuate at the sides, evenly and circularly rounded at apex; humeri narrowly rounded, moderately exposed at base; omoplates subobsolete; disk finely, closely punctate, the punctures becoming quite coarse and dense toward base. *Abdomen* opaque, densely and strongly granulato-reticulate, not punctate, minutely pubescent. *Legs* rather long and slender, the hind femora with a fulvous comb beneath, and another, smaller and shorter, between this and the base. Length 1.75 mm.; width 0.6 mm.

Florida (Lake Monroe).

The single type is a male, the intromittent organ being very slender, cylindro-acuminate and three-fourths as long as the entire abdomen. The third ventral is obliquely truncate at the sides and is distinctly longer than the second, the fourth shorter than the third, broadly bisinuate and feebly biimpressed along its anterior edge, the posterior edge broadly and very obtusely angulate; the genital segment is narrow and emarginate. In both of these species the posterior margin of the pronotum has a small and feeble median sinus.

#### CNOPUS Champ.

The body in *Cnopus* is somewhat as in *Vanonus* but rather shorter, polished and sparsely clothed with moderately long coarse and decumbent hairs in a single system. Head much wider than the prothorax, the eyes large, globular, occupying the entire sides and extending to the base, without trace of an anterior emargination, very coarsely faceted and with setæ so extremely minute as almost to defy detection under a power of 80. Front slightly declivous before the antennæ, but with the epistomal suture apparently obsolete; base of the occiput on a level with the anterior margin of the pronotum, the constriction extending forward some-

what in a transversely sinuous excavation. Last joint of the maxillary palpi rather small, right-angled, of the labial unusually large, strongly transverse, with the deeply concave oval apex pilose. Antennæ filiform, moderate in length. Middle coxæ narrowly, the posterior rather widely, separated. Basal segment of the abdomen larger than the remainder, with scarcely a trace of the dividing suture. Legs slender, the hind femora not dilated, simple beneath, the tarsi short, with the basal joint abbreviated and much shorter than the remainder.

Our single species of this distinct genus, erected by Mr. Champion (Biol. Cent.-Amer., IV, 2, p. 460) for the minute Mexican *C. flohri* is the following:—

1. **C. impressus** Lec.—Trans. Am. Ent. Soc., 1875, p. 175 (Xylophilus).

Piceous, shining, sparsely pubescent. Head polished, convex, finely, not densely and indistinctly punctate; antennæ one-half as long as the body. Prothorax transverse, with two deep sub-basal impressions which are feebly connected transversely, finely, rather strongly and moderately closely punctate. Scutellum short and wide, small, in the form of a perfect parallelogram. Elytra oblong-oval, scarcely one-half longer than wide, nearly twice as wide as the prothorax, finely but strongly, not very densely punctate. Abdomen alutaceous. Length 1.1 mm.; width 0.45 mm.

Texas,—Cab LeConte; Florida. This species differs from *flohri* in its much shorter antennæ, which, in the latter, are said to be three-fourths as long as the body. Excepting *Axylophilus yuccæ*, this is by far the most minute xylophilide thus far discovered in the United States; it probably occurs on maritime plants along the shore line of the Gulf of Mexico.

**GANASCUS** n. gen.

The complete lack of a basal cephalic constriction, which renders this and the following two genera so aberrant, is somewhat suggested in *Cnopus*, where the constriction is carried forward, leaving the basal part of the head on a level with the pronotum. The body is very obese and convex, clothed with a short coarse decumbent and matted pubescence, variegated in color and intermixed with sparser, semi-erect hairs arising from the larger punctures. Head vertical or slightly inflexed, broadly arcuate at base,

where it is in close contact with the prothorax, the vertex flat; epistomal suture fine but distinct. Eyes large, coarsely faceted, distinctly pilose, occupying the entire sides of the head and touching the prothorax at base, having a small but distinct anterior notch. Antennæ moderate in length, distinctly and gradually incrassate. Last joint of the maxillary palpi moderate in size, short, transverse, the basal angle broadly obtuse, that of the labial transversely excavated at apex and well developed. Scutellum rather large, equilatero-triangular, narrowly truncate at apex. Middle coxæ moderately separated, the posterior a little more widely. Abdomen with the basal segment fully as long as the entire remainder, divided before the middle by a fine but distinct suture throughout the width, the suture anteriorly arcuate in the middle; remaining segments short and equal. Legs somewhat short and stout, the hind femora only slightly stouter, finely subcarinate beneath; tarsi moderate, the basal joint normally elongate.

Although this genus is one of the most distinct of the subfamily, the species which compose it are closely allied and will prove a difficult study; the three which seem to be indicated by the material in my cabinet may be recognized as follows:—

Elytral punctures distinct and well separated, not concealed or obscured by the vestiture; elytra shorter and oval, the fuscous markings very much confused and scarcely at all definable.

Eyes larger, separated by their own width. ....1. **ventricosus**

Eyes separated by slightly more than their own width; head relatively smaller and more convex. ....2. **opimus**

Elytral punctures very dense and closely crowded, more or less obscured by the vestiture, the elytra longer and more oblong, with four distinctly defined irregular black spots at the middle of the disk; eyes separated by much more than their own width.....3. **palliatus**

Other species exist in collections, but I am not able to collate them at present. The sexual characters appear to be extremely slight.

1. **G. ventricosus** Lec.—Trans. Am. Ent. Soc., 1875, p. 176 (*Xylophilus*).

Stout, oval, strongly convex, dull, very densely pubescent, dark brown, the antennæ, tibiæ toward base and apex and tarsi pale luteo-flavate; upper surface mottled with the same pale tint, especially evident transversely at the apex and base of the pronotum.

tum, and, on the elytra, in a narrow and very uneven fascia at basal fourth, two subsutural spots at the middle and in scattered small spots toward apex, the scutellum pale and conspicuous. Head transversely subtriangular, feebly convex behind, perfectly flat anteriorly, finely, strongly and closely punctate; antennæ scarcely longer than the head and prothorax, slender, gradually but rather rapidly incrassate through the last four joints, the penultimate wider than long; labrum with a wide coriaceous apical border. Prothorax fully one-half wider than long and distinctly wider than the head, somewhat tumid at the sides before the middle, rapidly, sinuately oblique to the apex, the base broadly arcuate and quadrisinuate; disk rather finely but deeply, very closely and evenly punctato-cribrate, not impressed. Elytra scarcely one-fourth longer than wide, twice as wide as the prothorax, oval, the humeri rounded to the prothorax and well exposed at base; surface convex, not very coarsely but deeply, evenly and closely punctate throughout, the punctures distinctly defined and but slightly smaller toward apex. Under surface and abdomen not very coarsely but strongly and densely punctate throughout. Length 1.6 mm.; width 1.0 mm.

North Carolina. The oval and convex form of body, indefinable mottling of brown markings, and distinctly defined elytral punctures, will serve to identify this species, which is more northern in its range than the others.

2. **G. opimus** n. sp.—Broadly oval, strongly convex, the integuments rather shining and less densely pubescent than usual, piceous-black, the antennæ, extremities of the legs and some feebly and indefinitely nubilate spots on the upper surface paler. Head small, subtriangular, finely and not very densely punctate, the eyes separated by distinctly more than their own width; antennæ short, slender and filiform, as long as the head and prothorax, the last joint abruptly much thicker, obliquely and obtusely pointed, tenth quadrate. Prothorax very transverse, fully two-thirds wider than long, distinctly wider than the head, obtusely and feebly swollen at the sides anteriorly, obliquely sinuate at the basal angles, strongly and densely punctate. Elytra one-fourth longer than wide, distinctly more than twice as wide as the prothorax, oval, broadly arcuate at the sides, almost evenly rounded at apex, the humeri obliquely rounded to the prothorax and somewhat widely exposed at base; disk convex, not impressed except minutely and very feebly within the humeri at base, moderately coarsely, deeply and somewhat closely punctate, the punctures distinctly separated throughout. Abdomen finely punctate, sparsely so at the sides toward base, the legs rather short and stout. Length 1.4 mm.; width 0.85 mm.



Texas (Austin).

Readily distinguishable from the preceding by its smaller size, more shining surface, smaller head and prothorax, the latter more transverse, sparser punctuation and, especially, by the antennal structure, the eleventh joint in *ventricosus* not being abruptly wider than the preceding. The single specimen serving as the type is a male, and has a rather singular, abruptly pointed form of intromittent organ, which, as in other species of the subfamily, seems to be slightly asymmetric.

3. **G. palliatus** n. sp.—Oblong-oval, convex, opaque, black beneath, the antennæ, tibiæ and tarsi pale; upper surface pale, with the middle of the pronotum transversely darker, and with black maculation on the elytra, especially evident near the scutellum, along the flanks, and in four central spots; vestiture very dense, obscuring the punctuation, more especially in the pale areas. *Head* small, rather finely and moderately sparsely punctate, the eyes separated by nearly one-third more than their own width; antennæ almost one-third as long as the body, filiform, the last joint abruptly thicker, obliquely pointed and nearly as long as the two preceding, tenth somewhat longer than wide. *Prothorax* strongly transverse, wider than the head, two-thirds wider than long, parallel at the sides, more rounded and feebly prominent anteriorly; base broadly arcuate, with two feeble sinuations at each side; disk strongly, very densely punctate. *Elytra* oblong-oval, about one-third longer than wide, not quite twice as wide as the prothorax, parallel and feebly arcuate at the sides, becoming less so near the base, evenly and somewhat parabolically rounded behind, the humeri broadly rounded to the prothorax; disk transversely flattened or subimpressed near the base, somewhat coarsely and very densely cribrate. Under surface rather finely but strongly, closely punctate. Length 1.6 mm.; width 0.85 mm.

Florida (Tampa). Hubbard and Schwarz.

The antennæ are nearly as in *opimus*, but the form of the body and distinctly defined black maculæ of the elytra will distinguish it quitereadily.

#### **SANDYTES** n. gen.

Body oblong, convex, the vestiture coarse, short, subdecumbent, rather sparse, with condensed patches of short matted white hair. Head wider than the prothorax, the eyes large, globular, somewhat coarsely faceted and with very minute and scarcely visible erect setæ, extending extremely nearly to the base and almost in contact with the prothorax, deeply emarginate anteriorly. Epistomal suture completely obsolete. Antennæ very long, slender and cylindrical, the two basal joints small and sub-

globular, the third and fourth equal and more elongate, five to eleven still longer, equal among themselves, cylindrical, pilose, not incrassate, the eleventh a little thicker, cylindro-obconic, with the apex abruptly and obliquely obtuse. Last joint of the maxillary palpi a little more than right-angled, of the labial short, extremely dilated and transverse, the apex concave and pilose. Scutellum rather small, trapezoidal, somewhat tumid, minutely and very densely punctate. Middle coxæ narrowly separated, the posterior more widely, the abdominal process narrowly rounded. Abdomen with the basal segment shorter than the remainder, the dividing suture distinct throughout the width. Legs unmodified, the hind femora but slightly dilated; basal joint of the tarsi normally elongate.

This genus, while related to *Ganascus*, differs greatly in antennal structure, in its deeply emarginate eyes—the emargination, however, not being so deep as in the first three genera of the subfamily,—in its narrow and subcylindrical prothorax, and in general habitus. There is but one species, as follows:—

1. ***S. ptinoides*** Schz.—Proc. Am. Phil. Soc., XVII, 1878, p. 371 (*Xylophilus*).

Polished, black, the antennæ, palpi and legs pale flavo-testaceous, the intermediate femora slightly, the posterior deeply, blackish; interspaces between the punctures not at all reticulate; pubescence rather sparse and inconspicuous, except the coarser short white hairs, which are distinct on the head, in two narrow uneven pronotal vittæ and at the sides toward base, and in a transverse uneven spot at basal fifth of each elytron, and another smaller and subsutural at apical two-fifths, these pubescent areas apparently rufescent. Head densely, coarsely and deeply punctate, the eyes separated by scarcely two-fifths of their own width; antennæ more than three-fourths as long as the body. Prothorax rather distinctly narrower than the head, slightly wider than long, parallel and feebly bisinuate at the sides, the apex and base equal; disk strongly and densely punctate, feebly tumid along the middle toward base. Elytra one-half longer than wide, twice as wide as the prothorax, parallel and broadly arcuate at the sides, becoming straight and parallel in basal fifth; apex ogival; humeri rounded, somewhat broadly and subtransversely exposed at base; disk convex, not distinctly impressed, rather coarsely,

very deeply and densely punctate throughout. Abdomen convex, polished, strongly and closely punctate, the third segment slightly shorter than the second and much shorter than the fourth. Length 1.6 mm.; width 0.65 mm.

Florida (New Smyrna, Enterprise and Haw Creek),—Hubbard and Schwarz. A very interesting and widely isolated species. The single specimen before me is a male, the slender apex of the intromittent organ being feebly expanded in a small rounded button.

**AXYLOPHILUS** n. gen.

Body oval, convex, sparsely clothed with moderately short stiff and inclined hairs in a single uniform system. Head much narrower than the prothorax, against the anterior margin of which it is in close and even contact throughout, the surface forming also a low short laminate hood, which does not extend over the basal margin and which is continued narrowly behind the eyes, expanded again beneath and before the latter, where its glossy concave surface is separated longitudinally from the extended front by a tumid and sparsely hairy piece, extending from the mandibles to the point of antennal insertion; front broadly extended before the antennæ and as long as the entire basal part of the head. Epistomal suture coarse and very deep, the epistoma small, subquadrate, two-fifths as wide as the extended front. Labrum transverse, feebly convex, translucent, broadly bilobed at apex. Mandibles expanded with rounded outline, very thin and laminate. Eyes large but short, very near the base, transversely reniform, the anterior emargination containing the antennal base very large and deep; facets coarse; setæ distinct. Last joint of the maxillary palpi moderate in size, securiform, of the labial rather small though dilated and flattened. Antennæ slender, moderate in length, the second joint somewhat longer and stouter than the first; three to eight extremely slender and with very long sparse setæ; last three joints very gradually thicker, elongate-oval. Prothorax as wide as the base of the elytra, the humeral angles of the latter not at all exposed at base. Middle coxæ well separated, the posterior only a little more so, the abdominal process narrowly rounded. Abdomen with the basal segment a little larger than the entire remainder, the dividing suture visible at the extreme sides only. Legs rather long, very slender, the hind

femora but slightly thickened; tarsi slender, distinctly shorter than the tibiæ, the basal joint very much longer than the entire remainder.

It is almost impossible to describe the remarkable double surface at the posterior margin of the head in an intelligible manner, and, in view of this very aberrant structure, as well as the abnormal anterior parts of the head and the broad base of the prothorax, we must regard *Axylophilus* as the most specialized and extraordinary type of the entire subfamily; it is also the most minute representative within our faunal limits. The antennæ are very similar in form to those of *Trichopteryx*.

1. *A. yuccæ* n. sp.—Narrowly oval, polished, sparsely pubescent, piceous-black, the head, pronotum, base of the elytra and two fasciæ just before the middle and at apical fourth respectively, pale testaceous; legs and antennæ testaceous, the hind femora blackish except toward base and apex. *Head* strongly inflexed, convex, longer than wide, very minutely, sparsely punctate, the eyes separated by one-half of their own width; antennæ about one-half as long as the body. *Prothorax* four-fifths wider than long, very much wider than the head, the sides feebly convergent and nearly straight almost to the apex, then abruptly rounded and narrowed, the apex scarcely two-thirds as wide as the base, the latter transversely truncate, with a small and feeble sinuation at the scutellum; basal angles nearly right but blunt; disk moderately convex, subexplanate toward the basal angles, strongly and rather closely punctate. Scutellum transverse, feebly trapezoidal, polished. *Elytra* two-fifths longer than wide, just behind the middle two-fifths wider than the prothorax and distinctly wider than at base; sides arcuate; apex obtuse and subtruncate; disk scarcely visibly impressed near the base, strongly punctate, the punctures well separated. *Abdomen* more finely and densely punctate and pubescent toward apex. Length 0.75–0.9 mm.; width 0.45–0.5 mm.

Florida (Crescent City and Cape Jupiter).

This exceedingly interesting species was taken abundantly by Messrs. Hubbard and Schwarz, on plants of the genus *Yucca*.

#### OTIORHYNCHIDÆ.

The known forms allied to *Dyslobus* have become very numerous by reason of recent collecting on the west coast, where they constitute the most conspicuous and abundant otiorhynchide element of the true Pacific coast fauna; they are especially numerous and diversified in northern California and in Oregon. The larger and more striking of these species, which I have set apart for investigation at the present time may be assigned to four genera as follows:—

First ventral suture very deep and widely impressed, generally straight or only slightly arcuate in the middle; second segment not longer than the next two combined; met-episternal suture distinct; scutellum very short and broad, not entering the elytral disk.

Elytral intervals not alternating in convexity.....**Dyslobus**

Elytral intervals distinctly alternating in convexity throughout the length.

**Amnesia**

First suture fine, not broadly impressed and broadly arcuate.

Body squamose and pubescent; scutellum distinct; second ventral segment much longer than the next two combined; met-episternal suture distinct.

**Adaleres**

Body squamose, the elytra without erect hairs, the intervals alternating strongly in convexity and vestiture; scutellum extremely small, acute; second ventral segment not longer than the next two combined; met-episternal suture completely obliterated.....**Nomidus**

In this scheme *Amnesia* is limited to those species having the elytral intervals strongly alternating in prominence, and it is probable that other genera will ultimately have to be formed for the smaller and more obscure species, such as *rauca* and *decorata*, at present associated with them; it is more than probable that these forms can be included in *Lepesoma* of Motschulsky, although *L. californica* can never be identified without the type. I can find no essential difference in the form of the first ventral suture and relative extent of the second segment, which were advanced by Dr. Horn to distinguish *Dyslobus* from *Amnesia granicollis*, the type of *Amnesia*, and the differential character which that author attempts to draw from the internal terminal spur of the hind tibiae is wholly illusory and devoid of value in this particular connection.

These four genera are in fact intimately allied among themselves, having the beak rather elongate, separated from the head by a transverse depression and with the scrobes short, flexed gradually downward, broadening and becoming evanescent far before the eyes, and the ocular lobes at least moderately distinct throughout. In the table given by Dr. Horn (Proc. Am. Phil. Soc., XV, p. 38), *Dyslobus* and *Amnesia* are widely separated by a number of genera which are not particularly closely related to them, and in some cases widely dissimilar in important details of structure.

#### **DYSLOBUS** Lec.

The species of this genus are rather large and elongate, somewhat less so in the female than in the male, and have the ocular

lobes much broader and shorter than in *Amnesia*, the eyes being invariably far distant from the prothorax. The three species may be distinguished as follows:—

Elytral suture prominent and keeled near the summit of the posterior declivity; serial punctures each with a rather large scale but otherwise nude.

Serial punctures small; hind tibiæ very strongly bent near the apex in the male ..... **segnis**

Serial punctures much coarser; scales brilliantly metallic in color; hind tibiæ of the male only very feebly arcuate toward apex..... **lecontei**

Elytral suture not keeled near the apex but with a small and abruptly elevated double tubercle; serial punctures not squamigerous but each with a short hair attached anteriorly; scales in great part opalescent. **verrucifer**

*D. segnis* of LeConte (Pac. R. R. Rep., 1857, App. 1, p. 56), is rather abundant in the northern parts of California; it is uniformly and soberly clothed with small rounded pale brown scales having a pearly lustre, but which become feebly metallic beneath and on the legs.

**D. lecontei** n. sp.—Elongate and narrow, strongly convex, black, the antennæ and legs black throughout; scales small, rounded, dense throughout, pale greenish with coppery reflections, indefinitely nubilate with blackish on the elytra and still more indefinitely clouded on the pronotum, the paler scales more conspicuous on the femora in outer third. *Head* one-half as wide as the prothorax, the head and entire beak densely clothed with greenish scales intermingled with short hairs; interocular fovea wanting; eyes separated by three times their own width; beak stout and thick, not twice as long as wide, dilated at apex, thinner toward base in profile, two-thirds as long as the prothorax, the transverse impression distinct; antennæ very long and slender, the scape extending rather beyond the base of the eyes, very slender, thickened at apex, funicle as long as the entire prothorax, all the joints elongate, the two basal greatly so, seventh longer than the sixth, club narrow, elongate and acutely pointed. *Prothorax* as long as wide, the sides parallel and broadly arcuate, more convergent near the base, the latter subequal to the apex, both subtruncate, the ocular lobes short, broad and fimbriate; disk finely, sparsely and scarcely visibly punctate, squamose and with short erect brownish hairs. Scutellum extremely short, scarcely entering the disk. *Elytra* elongate, twice as long as wide, only slightly more than twice as long as the prothorax and but very slightly wider; sides parallel and very feebly arcuate, rather narrowly rounded behind; suture strongly keeled at the summit of the apical declivity, the latter nearly straight, deep and not quite perpendicular in profile; disk with feebly impressed series of rather coarse, deep, moderately close-set punctures, each enclosing a large rounded scale; intervals subequal, feebly convex, generally equally so, but occasionally with the alternate intervals very slightly more convex, having very short and unevenly distributed hairs in addition to the scaly vestiture. *Abdomen* densely scaly and pilose, the first

suture straight, feebly arcuate at the middle, the fifth segment impressed along the middle in the male. *Legs* long, the anterior tibiae very strongly bent near the apex, denticulate along the inner edge. Length\* 10.7–11.0 mm.; width 3.6–3.75 mm.

Washington State (Tacoma); Oregon.

One of the two males before me has a feebly impressed and entire median line of the pronotum which is altogether wanting in the other. I have not seen the female, but the elytra are probably shorter and broader in that sex, with the fifth ventral acutely triangular and not broadly rounded. The internal spur at the apex of the hind tibiae is extremely short and rudimentary.

**D. verrucifer** n. sp.—Ovoidal, strongly convex, black, the antennae and tarsi not paler; vestiture consisting of small rounded opalescent and pale bluish-gray scales, feebly and altogether indefinitely variegated with brown on the elytra and more extensively on the pronotum, also having numerous short erect hairs disposed without order on the elytral intervals. *Head* large and convex, three-fifths as wide as the prothorax, the eyes separated by barely three times their own width; beak rather stout, thick, much thinner toward base in profile, not more than one-half longer than wide and two-thirds as long as the prothorax, the transverse impression distinct; antennae long, the scape extending almost to the prothorax, clavate at tip, the funicle filiform but rather thick, scarcely as long as the prothorax, the second joint slightly longer than the first and subequal to the next two together, seventh much longer and thicker than the sixth, club very slender, gradually acute. *Prothorax* about as long as wide, the sides parallel and broadly arcuate, somewhat more distinctly so near basal third; apex and base equal; ocular lobes very broad, feeble and with a short dense fringe. *Elytra* barely one-half longer than wide, slightly more than twice as long as the prothorax and about one-half wider, the sides parallel and broadly arcuate; humeri obsolete, the basal margin however acute and prominent at the sides; apex narrowly rounded; suture strongly tuberculate at the summit of the declivity, thence deep, nearly straight and subvertical in profile to the apex; serial punctures somewhat coarse, deep, close-set, perforate and slightly elongate, each with a short anterior hair; intervals alternately flat and scarcely perceptibly convex. *Abdomen* rather finely and closely punctate, somewhat densely clothed with short coarse whitish pubescence interspersed with a few scales, the first suture straight and broadly, deeply impressed; fifth segment triangular and slightly tumid along the middle. *Legs* long, the anterior tibiae strongly and abruptly bent near the apex and minutely and distantly denticulate along the inner edge; terminal mucro of the hind tibiae rather distinct. Length 9.5 mm.; width 4.2 mm.

Idaho (Fort Cœur d'Alène). Lt. Jas. A. Leyden.

\* The measurements of length exclude the beak but include the head in all the Rhynchophora here described.

The single specimen is apparently a female, judging by the rather obese form of the body and the corresponding form of the fifth ventral in the female of *segnis*, but the tip of the ovipositor is very acute and corneous.

### AMNESIA Horn.

This genus is very closely allied to *Dyslobus*, but may be distinguished not only by the alternately convex elytral intervals, but by the greater prominence of the ocular lobes; there is considerable variation in the latter character, however, as is generally the case within generic limits, and the lobe is very much shorter and less distinct in *sculptilis* than in *tumida*. The species known to me may be thus outlined:—

Elytra sparsely but strongly tuberculose throughout, the sutural prominence

at the summit of the apical declivity very pronounced.....**tumida**

Elytra not tuberculose, the sutural prominence moderate or feeble.

Antennal funicle very long, much longer than the beak.

Body stout, convex; intervals tessellate with large black areas throughout the length.....**granicollis**

Body slender, at least in the male; elytral vestiture not much variegated.

Legs black, the anterior femora distinctly elongated in the male.

**discors**

Legs red, the anterior femora not elongated in the male....**sculptilis**

Antennal funicle much shorter, scarcely longer than the beak; anterior legs notably elongated in the male; body much smaller.....**debilis**

*A. granicollis* Lec. (Ann. Mag. Nat. Hist., 1869, p. 380,—*Dyslobus*), is northern in distribution, occurring in Vancouver Island and Oregon. *A. sculptilis* Csy. (Ann. N. Y. Acad. Sci., IV, p. 250), occurs in California to the northward of San Francisco.

The serial punctures in *Amnesia* are never squamigerous, each puncture having in all cases a small hair arising from its anterior margin.

**A. tumida** n. sp.—Ovoidal, moderately convex above, black, the antennæ and tarsi piceo-rufous; vestiture consisting of small rounded scales densely disposed in the interspaces between the shining tubercles, pale brownish in color and intermingled throughout with numerous short sub-erect hairs, the scales on the head and beak becoming long, slender and sparse. Head fully one-half as wide as the prothorax, the entire surface of the head and beak coarsely and densely punctato-rugose; transverse impression distinct; eyes separated by scarcely more than twice their own width; beak stout and thick, strongly dilated at apex, thinner in profile toward base, scarcely two-



thirds as long as the prothorax and one-half longer than wide, finely but strongly carinate in the middle in more than basal half; antennæ slender and very long, the scape extending beyond the eyes, gradually clavate at apex, the funicle nearly as long as the prothorax, the joints polished but with long sparse bristling hairs, all elongate, the first and second greatly so, the first almost as long as the second, the latter not as long as the next two combined, seventh scarcely wider and but little longer than the sixth, club elongate, evenly fusiform. *Prothorax* about as long as wide, the sides subparallel, broadly, almost evenly and rather strongly arcuate; apex subtruncate, slightly narrower than the base, the ocular lobes strong, fimbriate and about attaining the eyes; disk impressed along the median line, more deeply near the apex, rather closely covered with strong polished tubercles. Scutellum depressed, smooth, broadly triangular, not entering the disk of the elytra. *Elytra* two-fifths longer than wide, slightly more than twice as long as the prothorax and nearly four-fifths wider, sides parallel and broadly arcuate; humeri obsolete but with the basal margin acutely prominent at the sides; base broadly, feebly sinuate; apex rather narrowly obtuse; disk strongly, tubercularly swollen on the suture at the summit of the apical declivity, the latter deep and vertical in profile; alternate intervals convex, more strongly so and tumid at the summit of the declivity; striae unimpressed, the punctures moderate in size, each with a short anterior hair, the entire surface covered with shining tubercles. *Abdomen* coarsely and closely punctato-rugose, sparsely and coarsely pubescent, shining and not squamose, the first suture nearly straight, feebly arcuate in the middle. *Legs* rather long and stout, the anterior tibiae bent at apex and finely denticulate within; hind tibiae with long hairs, the internal terminal uncus distinct. Length 9.0-11.0 mm.; width 3.6-5.2 mm.

California (Sta. Cruz Mts.).

The description is taken from the female, the fifth ventral being subtriangular and broadly tumid along the middle. The male is smaller and much narrower, with the elytra only about one-fourth wider than the prothorax and the fifth ventral broadly rounded; I can perceive no radical differences in the legs, but the seventh antennal joint is more decidedly longer and thicker than the sixth.

**A. discors** n. sp.—Elongate, strongly convex, black, the tarsi and antennæ piceo-rufous; body clothed with scales intermixed with short erect dark hairs, the scales linear and dense on the head, sparse and hair-like on the beak, small, rounded and rather dense between the small tubercles and submetallic in color on the pronotum, a little larger, rounded, very dense and pale brown throughout on the elytra, a transversely arcuate series of uneven spots at the summit of the apical declivity white. *Head* about one-half as wide as the prothorax, the head coarsely, densely, the beak still more coarsely, densely and rugosely punctured; transverse impression distinct; eyes separated by barely twice their own width; beak nearly twice as long as wide, two-thirds

as long as the prothorax, feebly carinate in the middle toward base; antennæ long and slender, the scape extending scarcely beyond the eyes, gradually clavate toward tip and clothed throughout with coarse yellowish hairs, funicle distinctly shorter than the prothorax, clothed with coarse bristling hairs, the two basal joints much elongated and equal, seventh very much longer and thicker than the sixth, club elongate, acutely pointed and fusiform. *Prothorax* nearly as long as wide, the sides parallel, broadly and evenly arcuate, apex and base subequal, the former broadly arcuate; ocular lobes strong, fimbriate and attaining the eyes; disk very slightly uneven, closely covered with fine polished tubercles. *Elytra* two-thirds longer than wide, rather more than twice as long as the prothorax and about one-fourth wider, the sides parallel and broadly arcuate; apex broadly obtuse; humeri obsolete; base broadly, deeply emarginate, the margin acute and prominent at the sides; suture straight and subvertical at apex in profile, the intervals alternately flat and convex, the convexity more pronounced at the summit of the declivity, the sutural intervals not so distinctly so however as the third; serial punctures moderate in size and distance, each with a small anterior hair; surface throughout with very small sparse and black subtuberculate punctures. *Abdomen* shining though rugosely sculptured, coarsely pubescent, with a few scales toward the sides near the base, the first suture very coarse, straight, broadly and feebly arcuate in about median third, the second segment barely equal to the next two. *Legs* long and slender, the anterior strikingly longer and thicker in the male, the anterior tibiæ internally bent at apex and denticulate within; tibiæ densely clothed with long erect hairs, the inner spur of the posterior not visible. Length 9.0 mm; width 3.5 mm.

#### California.

This species is allied to *sculptilis*, but differs in the color and structure of the legs, tubercular and not confusedly rugose sculpture of the pronotum, smaller serial punctures, and presence of a transversely arcuate series of white spots at the summit of the apical declivity. The description is drawn from the male, the fifth ventral being broadly rounded. Two specimens.

**A. debilis** n. sp.—Narrow, subparallel, strongly convex, black, the tarsi and antennæ rufo-piceous; body clothed with small rounded scales plentifully intermixed with rather short, coarse and brownish hairs, which are very conspicuous on the elytra, the scales on the head elliptical, dense and subcupreous, becoming sparser on the beak, moderately dense and submetallic on the pronotum, quite dense and pale brownish on the elytra. *Head* quite distinctly less than one-half as wide as the prothorax, the eyes separated by scarcely twice their own width; transverse impression distinct; beak nearly twice as long as wide and three-fourths as long as the prothorax, rugosely sculptured, not distinctly carinate; antennæ long but rather thick, coarsely pubescent, the scape extending to about the base of the eyes, funicle of the usual structure but less elongate. *Prothorax* not quite as long as wide, the sides strongly

arcuate; apex feebly arcuate, much narrower than the base, the ocular lobes strong and attaining the eyes; disk very slightly uneven, narrowly impressed along the median line, the surface not tuberculose but very obscurely punctured. *Elytra* two-thirds longer than wide, much more than twice as long as the prothorax but not more than one-fifth wider, the sides parallel and feebly arcuate; apex broadly obtuse; humeri obsolete but with the basal margin acute and prominent at the sides; base broadly emarginate in circular arc; suture strongly declivous and nearly straight in profile at apex, but making an angle of scarcely more than forty-five degrees with the side margins and not abruptly limited above, the intervals alternately flat and moderately convex but only slightly more prominent at the summit of the declivity, the third more noticeably tumid; serial punctures moderately coarse and close-set, each with the usual hair, the surface not visibly punctate or rugose. *Abdomen* shining, feebly punctato-rugose, sparsely pubescent and with a few scales toward the sides, the first suture straight, feebly arcuate in the middle. *Legs* moderate, the anterior longer in the male, the anterior tibiæ denticulate within and very strongly bent at apex. Length 6.5 mm.; width 2.5 mm.

#### Oregon.

The unique type is a male, as shown by its narrow form and broadly rounded fifth ventral; the first segment is strongly impressed in the middle at the posterior margin.

#### ADALERES n. gen.

In general organization this genus is closely allied to *Dyslobus*, differing in the fine and broadly arcuate first suture of the abdomen, and in having the second ventral much longer than the next two combined. The apex of the hind tibiæ is oblique and somewhat cavernous, but not distinctly unguiculate. The two species may be distinguished as follows:—

|   |                  |
|---|------------------|
| Humeri broadly rounded; elytral intervals not alternating in convexity or only very slightly so near the apex; pronotum nearly smooth and densely and evenly squamose.....  | <b>ovipennis</b> |
| Humeri oblique, obtusely prominent at a slight distance behind the base; elytra more oblong and less oval, the intervals alternately more convex, the suture prominently keeled at the posterior declivity; pronotum coarsely granulose and irregularly squamose..... | <b>humeralis</b> |

This genus differs further from *Dyslobus* in having the first three joints of the antennal funicle more or less distinctly elongated. The serial punctures of the elytra are rather small, somewhat distant, each enclosing a rounded scale attached anteriorly.

**A. ovipennis** n. sp.—Elongate-oval, strongly convex, black, the antennæ and tarsi not paler; body very densely clothed throughout to the tip of

the beak with small rounded uniformly pale brownish, closely adherent scales, intermingled with numerous short erect hairs, the scales of the pronotum slightly larger. *Head* large, convex, a little more than one-half as wide as the prothorax, the eyes separated by slightly more than twice their own width; transverse impression moderately deep but evident; beak stout and long, not quite twice as long as wide, slightly shorter than the prothorax, rather abruptly and strongly dilated at apex, densely squamose and nearly smooth, the sculpture not evident, having a deep oval perforate dorsal fovea near apical third, the median line thence finely and feebly carinate to the base; antennæ long, the scape relatively rather short, only extending slightly upon the eyes, the funicle very long, about as long as the prothorax, sparsely bristling with long hairs, the basal joint slightly longer than the second, the latter much longer than the third, which is in turn quite distinctly longer than the fourth, seventh much longer than the sixth, obconical, club not longer than the last two joints of the funicle, gradually pointed. *Prothorax* relatively small, not quite as long as wide, the sides parallel and feebly arcuate, becoming gradually almost straight in basal half, a little more convergent and rounded near the apex, which is truncate and not quite as wide as the base; ocular lobes small, moderately developed, briefly fimbriate, not quite attaining the eyes; disk even, very obsoletely impressed along the median line and without exposed sculpture. *Elytra* large, oval, rather more than one-half longer than wide, more than three times as long as the prothorax and two and one-third times as wide, the sides parallel and arcuate; apex acute; humeri broadly rounded and obsolete, the basal margin not rounded but not prominent at the sides, the base evenly sinuate in circular arc and equal in width to the base of the prothorax; disk even, the suture becoming slightly prominent near the declivity, which is subvertical and feebly sinuate in profile; serial punctures small and rather distant, each with a large scale; intervals wide, equal and very feebly convex, very evenly and extremely densely squamose. *Abdomen* nearly flat, densely squamose and pilose. *Legs* long, the anterior tibiæ gradually bent toward apex, sparsely denticulate within; posterior strongly dilated at apex; third tarsal joint very widely bilobed. Length 10.8–14.5 mm; width 4.3–6.3 mm.

California (Sonoma Co.).

The description is drawn from the female, the fifth ventral being equilatero-triangular and nearly flat. The male is smaller and much more slender, but does not differ in the form of the legs. The prothorax in the male frequently has the sides feebly convergent and nearly straight from apical fifth or sixth to the base, and the fifth ventral is parabolic in outline. This species does not appear to be rare, and I have before me a large series; one specimen is marked "Mojave Desert," but possibly in error. In some individuals a sublateral sulcus of the beak is quite pronounced, but the character is gradually evanescent.

**A. humeralis** n. sp.—Oblong-oval, moderately convex above, black, the antennæ and tarsi not paler; body clothed with small rounded and closely adherent, dark red-brown scales, with short sparse and whitish hairs intermingled, the scales dense and feebly cupreous on the head and beak. *Head* large, convex, rather more than one-half as wide as the prothorax; eyes separated by between two and three times their own width; transverse impression feeble; beak very stout, subcylindrical, thick, thinner toward base in profile, rather feebly but abruptly dilated at apex, one-half longer than wide and slightly shorter than the prothorax; antennæ very long, inserted almost at the extreme apex, the scape impinging on the eyes and gradually increasing in width from the base, the apex clavate, funicle longer than the prothorax, sparsely setose, the first three joints notably elongate, the first longer than the second or third, the latter equal, three to six gradually shorter, the latter only a little longer than wide, seventh one-half longer than the sixth, obconical, club rather small, narrow, pointed. *Prothorax* somewhat wider than long, the sides subparallel and broadly, almost evenly arcuate; apex truncate, a little narrower than the base; ocular lobes distinct; disk even in convexity, coarsely, subtubercularly sculptured, the interspaces squamose, the median line very finely and feebly impressed. *Elytra* two-fifths longer than wide, nearly three times as long as the prothorax and twice as wide; sides parallel and very feebly arcuate behind the obtuse post-basal protuberance; apex acute; base sinuato-truncate, the basal margin not rounded but not prominent at the sides; disk finely and extremely densely squamose throughout, the intervals wide, alternately flat and broadly convex, the convexity only slightly more marked behind, except the sutural interval, which becomes strongly prominent at the summit of the apical declivity, the latter not very deep, or abrupt but vertical and broadly sinuate in profile. *Abdomen* densely squamose and sparsely pubescent, the first suture fine and broadly arcuate, the first two segments very large; fifth flat and rather acutely triangular. *Legs* long, the anterior tibiæ slightly bent inward at apex, the internal denticles not very distinct; posterior straight. Length 9.0–12.5 mm.; width 3.75–5.7 mm.

California (Sta. Barbara).

The description is taken from the female, and the male is much smaller and narrower, with more oval and less rectilateral elytra. The beak is finely carinate and with the surface somewhat uneven in broad longitudinal folds. Five specimens.

#### **NOMIDUS** n.gen.

In this genus the elytra are oval, with the humeri rounded and the basal margin rather obtuse at the sides, the beak and scrobes as in *Amnesia*, the legs notably shorter and the hind tibiæ not distinctly mucronate. It differs from *Amnesia* in the fine, broadly arcuate first ventral suture, and, from all the other genera of the *Dyslobus* group, in the obliteration of the met-episternal suture.

This genus has some relationship also with *Phymatinus*, but differs in its transverse frontal impression and shorter second ventral segment. The single species known at present may be described as follows:—

**N. abruptus** n. sp.—Oval, convex, black, the antennæ not paler; tarsi dark rufous; integuments extremely densely clothed to the tip of the beak with rounded, uniformly dark red-brown and strongly strigose overlapping scales, a longitudinal line at each side of the prothorax in basal half white. *Head* moderately large, barely one-half as wide as the prothorax; eyes separated by scarcely more than twice their own width, the scales immediately bordering them above whitish; transverse impression somewhat feeble; beak more than one-half longer than wide and nearly as long as the prothorax, moderately stout, very strongly and rather abruptly dilated at apex, flattened but not distinctly carinate above, very obsoletely and longitudinally sulcate near the sides, the scrobes flexed downward, rapidly becoming shallow and disappearing at scarcely more than one-half the distance to the eyes; antennæ moderately elongate, rather stout, the scape extending to about anterior third of the eyes, stout, somewhat claviform and densely squamose, funicle coarsely setose and with shorter denser hairs, the two basal joints more elongate, seventh longer and much thicker than the sixth, not quite as long as wide, club elongate-oval, moderately stout, longer than the two preceding joints combined and gradually, acutely pointed. *Prothorax* not quite as long as wide, the sides subparallel, broadly and obtusely subangulate just before the middle, thence nearly straight to base and apex, the base wider than the apex with the margin slightly prominent at the sides; apex truncate, the ocular lobes large, strongly rounded, almost attaining the eyes and with an extremely short coarse loose fringe; disk rather coarsely and indefinitely rugose, finely impressed along the median line except toward base. Scutellum very small but entering the disk of the elytra, flat, deeply depressed, acutely angulate and longer than wide. *Elytra* stout, two-fifths longer than wide, two and one-half times as long as the prothorax and not quite twice as wide, the sides rounded, gradually more convergent posteriorly, the apex acutely rounded; intervals alternately flat and perfectly evenly paved with scales without trace of setæ or punctures, the convex intervals having large, elongate, decumbent strigose and darker scales in addition; serial punctures not very large or close-set, each enclosing a large scale; suture rather more prominent behind, the declivity distinctly inflexed throughout in profile. *Abdomen* flat, densely clothed with a mixture of rounded and elongate strigose scales of various shades of gray and brown, the elongate scales becoming longer, more erect, stout hairs toward apex. Met-episterna not defined by a visible suture. *Legs* rather short and stout, the hind tibiæ bent outward distally; third tarsal joint strongly bilobed. Length 7.5 mm.; width 3.5 mm.

California.

The head, beak and pronotum have, in addition to the scaly

covering, some short, slender, more or less erect strigose-scales or scale-like hairs. The unique type has the fifth ventral flat and narrowly parabolic in outline. The contrast between the evenly imbricate flat, and the dual vestiture of the convex intervals, is very striking.

**MELBONUS** n. gen.

Body elongate-oval and strongly convex, the surface nearly smooth and densely squamose. Head not separated from the beak by a transverse depression, having a minute interocular fovea. Eyes oval, convex, distant from the prothorax and very obtusely pointed beneath. Beak only slightly narrower than the head, longer than wide, feebly dilated at apex, the alæ broadly rounded. Mentum large, filling the entire buccal opening. Scrobes narrow, deep and well defined throughout, obliquely descending to the lower angle of the eye. Antennæ long, the scape rather thick and short, gradually enlarged at apex, extending beyond the middle of the eyes; funicle long but somewhat thick, filiform, the two basal joints longer, the second longer than the first and about twice as long as wide; three to six equal and only slightly longer than wide; seventh slightly thicker and much longer than the sixth, obconical; club well developed, fusiform, somewhat obliquely pointed, as long as joints four to six of the funicle combined, and about twice as thick. Ocular lobes completely obsolete and with the edge not at all fimbriate. Scutellum very short and broad, not entering the disk of the elytra. Prosternum extremely short and broadly, feebly sinuate before the coxæ, long and subcarinate along the middle behind them. Middle coxæ narrowly, the posterior more widely separated. Metasternum moderately long, the episterna narrow, internally and angularly prominent anteriorly, defined by a distinct suture. Abdomen long, the first suture moderately coarse, straight at the sides, arcuate in median half; second segment much longer than the next two combined. Legs moderately long and rather stout, the femora not much inflated; anterior tibiæ only feebly arcuate toward apex, not denticulate within, the posterior straight, moderately dilated at apex, the articular surface oblique and with a double outer edge, the internal spur not distinct; tarsi well developed, spongy-pubescent beneath, the third joint broadly bilobed; claws rather long, divergent.



As the supports of the deciduous pieces of the mandibles are very prominent, I am disposed to place this genus near *Diamimus*. It however differs greatly in having no vestige of a transverse depression separating the head from the beak.

**M. scapalis** n. sp.—Narrowly ovoidal, black, the antennæ and tarsi not paler; body densely clothed above and beneath with rather small, oval, slightly overlapping and strongly strigose scales, which are pale brownish in color but becoming indefinitely whitish along the flanks and beneath, and very feebly variegated with a slightly paler tint at the base and near the apical declivity of the elytra, the scales intermingled throughout with numerous short, stout, erect and brownish hairs which are unevenly arranged on the elytra. *Head* scarcely one-half as wide as the prothorax, the eyes prominent and separated by two and one-half times their own width; beak short and broad, one-fourth longer than wide, two-thirds as long as the prothorax and distinctly longer than the head, broadly impressed along the middle toward apex but not carinate or otherwise modified; antennal scape densely clothed with narrow whitish scales and bristling with sparse erect setæ, the funicle equally bristling and also clothed densely with short stout appressed whitish hairs, the club equally densely clothed with stout brown hairs and with a few short erect setæ. *Prothorax* not quite as long as wide; apex and base rectilinearly truncate, the former distinctly the narrower; sides evenly and distinctly arcuate; disk densely squamose, finely, sparsely punctate and with a feebly and indefinitely impressed median line. *Elytra* three-fourths longer than wide, not quite three times as long as the prothorax and fully one-half wider; sides parallel, evenly and broadly arcuate, the apex rather narrowly rounded; base strongly sinuate, the humeri obsolete, the basal edge not prominent but also not rounded at the sides; disk with scarcely impressed series of rather small deep and distant punctures, each bearing a slender whitish strigose scale; intervals equal, almost flat, finely, sparsely punctate, densely squamose, each puncture bearing a stout erect hair. *Abdomen* densely griseo-squamose and with short sparse and whitish erect hairs; fifth segment parabolic in outline. Length 8.5 mm.; width 3.25 mm.

Arizona.

The sex of the single type specimen is not determinable at present. The posterior declivity of the elytra is rather deep and nearly straight and vertical in profile, but the summit is not prominent and joins the general outline of the upper surface by a broadly rounded arc.

## CURCULIONIDÆ.

### LEPYRUS Schönh.

The species of *Lepyrus* are moderately numerous in the colder parts of the North American continent, and are mutually dis-



tinguishable by sculptural features which appear to be virtually constant and easily perceived, The characters made use of by LeConte for the separation of *palustris* Scop. (= *colon* L.) and *geminatus*, are not at all satisfactory, and there is every reason to suppose that the species of Say, is identical with the one which we have heretofore regarded as *colon* Linn., on the authority of Kirby and Schönherr. On this hypothesis the American species may be defined as follows :—

Elytral intervals alternating both in width and convexity, separated rather by continuous striae than by series of punctures.

The intervals differing greatly in width but polished and coarsely and similarly rugose throughout; striae well impressed and marked by a continuous line of white squamules; elytra without trace of an ante-median squamose spot.....**gemellus**

The intervals alternately slightly narrower, more depressed and much more finely sculptured; rostral carina broad and feeble.

Elytra with numerous irregular condensed areas of pale scales throughout, the usual spot before the middle not distinguishable; narrower intervals clothed in great part with denser brown squamules.

**errans**

Elytra each with a small spot of condensed squamules before the middle.

**alternans**

The intervals differing but slightly in width and convexity and similarly finely and rugosely sculptured throughout, the narrower intervals clothed in great part with darker brownish scales; elytra each with a condensed spot of pale scales before the middle; rostral carina fine, strongly elevated and entire.....**canadensis**

Elytral intervals mutually similar as nearly so and similarly clothed throughout, separated by series of detached punctures; each elytron constantly with a small pale squamose spot before the middle.

Serial punctures moderately large, rounded and less unequal among themselves.

Beak finely carinate throughout.

Elytra about twice as wide as the prothorax, having numerous small condensed spots of ochreous scales situated between the serial punctures; form stout.....**pinguis**

Elytra evidently less than twice as wide as the prothorax, the humeri less exposed at base and the elytra more gradually declivous behind in profile; vestiture much less dense.....**geminatus**

Beak not carinate toward base; elytra twice as wide as the prothorax, the sutural angles prominent.....**oregonus**

Serial punctures very unequal in size and unevenly spaced, the larger elongate, deep, perforate and very conspicuous; elytra deeply notched at apex, the sutural angles prominent.....**perforatus**

**L. gemellus** Kirby—Faun. Bor. Am., IV, p. 198, Pl. 5, f. 7; Mann.: Bull. Mosc., 1852, ii, p. 351; Lec.: Proc. Am. Phil. Soc., XV, p. 127.

Elongate-oval, the elytra gradually declivous behind, black, clothed with narrow white scales in the elytral sulci, in the usual oblique sublateral pronotal vittæ and less densely on the head, beak and toward the median parts of the pronotum. Beak long and strongly carinate, the two basal joints of the antennal funicle equal and moderately elongate. Prothorax large, about as long as wide, strongly carinate. Elytra oval, gradually ogival behind, the sutural notch very small, three times as long as the prothorax and much less than twice as wide. Length 12.5 mm.; width 5.5 mm.

Hudson Bay Territory and Alaska. The legs are long and the femora are not annulate, as is the case in most of the species, but the sublateral abdominal spots of condensed scales are distinct.

**L. errans** n. sp.—Elongate-oval, black, the integuments polished throughout when denuded; vestiture consisting of narrow scales, longer, sparser and hair-like on the median parts of the pronotum and along the rostral carina, whitish in the usual oblique sublateral vittæ of the pronotum and in numerous small condensed spots on the elytra, the narrower and more depressed intervals clothed in great part with pale yellowish scales; abdomen with the usual sublateral series of small condensed whitish spots. Head much less than one-half as wide as the prothorax, densely albido-squamulose, the eyes separated by rather less than twice their own width; interocular fovea narrow, deep and elongate; beak slightly longer than the prothorax, densely punctat rugose, squamulose and feebly carinate above throughout, the apical dilatation moderately gradual; basal joint of the antennal funicle distinctly longer than the second, the latter only a little longer than wide. Prothorax large, one-fourth wider than long, the sides feebly divergent and nearly straight from the base to about the middle, there obtusely subangulate and thence more convergent and somewhat reëntrant to the apex, which is three-fourths as wide as the base; disk coarsely rugose, with a pronounced median carina. Elytra much less than twice as wide as the prothorax and less than one-half longer than wide, gradually declivous behind, the sutural angles scarcely divergent; striae rather indefinitely punctate, the intervals rugose, the narrower much less coarsely and strongly than the wider. Length 12.0 mm.; width 5.4 mm.

New Mexico. Mr. Wickham.

This distinct species may be identified by the peculiar disposition of the vestiture and other characters as given in the table. One specimen.

**L. alternans** n. sp.—Elongate and moderately stout, black throughout, the integuments rather dull when denuded; elytra each with a small spot of

pale scales just before the middle. *Head* less than one-half as wide as the prothorax, short, broadly conical, rather coarsely and closely punctate, scarcely at all rugose; eyes moderately convex, separated on the front by more than twice their own width, the interocular fovea in the form of a short and deep canaliculation; beak as long as the prothorax, rather stout and convex, parallel, the apical dilatation somewhat abrupt, surface coarsely, closely and unevenly punctate, the dorsal carina subentire but feebly elevated; antennæ long and stout, the two basal joints of the funicle equal and elongate, the next four small, equal and subglobular, the seventh wider, forming a broad support for the elongate and pointed club, as usual. *Prothorax* one-fifth wider than long, the sides parallel and feebly sinuate to about apical third, then rapidly rounded and convergent to the broadly subtubulate apex, which is three-fourths as wide as the base; disk very densely punctato-rugose, the median carina distinct throughout. *Elytra* oval, one-half longer than wide, three-fourths wider than the prothorax, the sides parallel and broadly arcuate, converging toward the humeral angles which are but little exposed; disk gradually declivous behind, the apex conjointly rounded, the sutural angles not at all produced; alternate intervals narrower, more depressed and much more finely sculptured, the broader not coarsely rugose. Length 10.0–11.3 mm.; width 4.4–4.8 mm.

#### New Hampshire.

Distinguishable from *canadensis* by its more elongate form, much more gradually and feebly declivous apical parts of the elytra, more obtuse rostral carina and more finely and less rugosely sculptured elytra. The two specimens before me are almost completely denuded throughout, so that it is impossible to describe the vestiture.

***L. canadensis*** n. sp.—Stout, suboval, strongly convex, black, the rugosities polished; vestiture consisting of moderately dense slender scales, pale brownish in color, variegated with nubilate patches of white toward the sides of the elytra, with a white spot before the middle of each, the narrower intervals principally clothed with brown scales; oblique vittæ of the prothorax narrow and white. *Head* densely clothed with long hair-like brownish squamules, a large median area sparsely punctate, shining and almost glabrous, the fovea in the form of a deep elongate sulcus; eyes convex, separated by fully twice their own width; beak stout, slightly flattened, a little longer than the prothorax, bent and rather rapidly dilated toward apex, roughly punctato-rugose, the carina strong and entire; antennæ with the two basal joints of the funicle elongate and equal. *Prothorax* only slightly wider than long, the sides parallel and slightly uneven to about apical third, then rounded to the broadly subtubulate and truncate apex; disk very roughly and tubercularly rugose, the carina strong, extending very nearly to the basal margin. *Elytra* less than one-half longer than wide, fully twice as wide as the prothorax, obtusely rounded behind, the suture with a very minute notch, the angles not prominent; umbones feeble, each marked by a feeble point of white scales; humeri

somewhat exposed at base; disk evenly rugulose throughout; striae rather narrow, deep and not distinctly punctate. Length 11.0 mm.; width 5.0 mm.

Canada (northwest).

Quite distinct from *geminatus* by the sculpture of the elytra, and from *alternans* by the equal rugosity of the elytral intervals. The elytra are rapidly declivous behind in profile.

**L. pinguis** n. sp.—Obese, black and polished when denuded, densely clothed with narrow pale brown scales intermixed with still narrower white scales, and variegated on the elytra with small condensed spots of the brown scales situated between the serial punctures; oblique sublateral vittae of the pronotum broad, yellow and uneven; elytra each with a more conspicuous ochreous spot before the middle; abdomen with the sublateral yellowish spots small. *Head* one-half as wide as the prothorax, densely squamose, the eyes separated by about twice their own width, the fovea small and elongate; beak large, distinctly longer than the prothorax and broader than in the allied species, rather gradually dilated at apex, densely rugose, the median carina fine and very feeble; antennal funicle bristling with long white hairs, the two basal joints elongate and equal. *Prothorax* one-fourth wider than long, the sides parallel, just visibly converging toward base, rounded anteriorly to the feebly subtubulate apex, the latter fully three-fourths as wide as the base; disk strongly and closely rugose and distinctly carinate. *Elytra* not one-half longer than wide and almost twice as wide as the prothorax, the sides parallel and nearly straight from behind the humeri to the middle, then gradually convergent, the apex rather narrowly rounded; humeri rounded but unusually widely exposed at base; disk strongly and arcuately declivous behind, the sutural angles very slightly but obtusely prominent; sculpture uniformly finely, densely and strongly rugose, the serial punctures moderately large, distant and differing somewhat in size. Length 10.5 mm.; width 4.9 mm.

Colorado (Rocky Mts.).

This species is allied to *geminatus* and the European *palustris*, but is distinguishable from the former by its more obese form, stouter beak and coarser punctuation, more exposed humeri, more declivous elytra and denser vestiture, and from the latter by the rostral carina and many other characters.

**L. geminatus** Say—Curc., p. 12; ed. Lec., I, p. 273; *colon* Sch., Kirby and Lec. nec Linn.

Rather narrowly suboval, black, the rugosities shining; body not very densely clothed throughout with small slender brown and whitish scales, with minute denser whitish clusters separating the serial punctures; dense sublateral vittae of the pronotum yellowish, narrow and strongly oblique; each elytron with a small rounded spot of dense yellowish scales just before the middle; ab-

dominal spots distinct and ochreous in color. Head much less than one-half as wide as the prothorax, densely punctate, squamulose, the fovea small and slightly elongate; eyes rather convex, separated by perceptibly less than twice their own width; beak slender, about as long as the prothorax, somewhat gradually dilated at apex, densely punctate, the dorsal carina strong and subentire; antennæ moderately stout, the second funicular joint a little narrower and much longer than the first. Prothorax one-fourth wider than long, the sides unevenly convergent from base to apex, obtusely prominent before the middle; apex not more than two-thirds as wide as the base, rectilinearly truncate as usual; disk coarsely and densely punctato-rugose, the median carina narrow and strongly elevated. Elytra nearly one-half longer than wide, distinctly less than twice as wide as the prothorax, gradually and arcuately narrowed in ogive behind the middle, the sutural angles individually slightly and obtusely prominent; humeri rounded to the prothorax; disk in profile gradually and rather feebly declivous behind to the immediate apex, which is somewhat porrect, finely and densely punctato-rugose throughout. Length 9.0–10.2 mm.; width 3.9–4.5 mm.

Wisconsin (Bayfield,—Mr. Wickham) and Missouri. This species has heretofore been confounded with the European *palustris* Scop., which it somewhat resembles. It differs however from *palustris*, as represented by the numerous European examples before me, in its more elongate form, much larger and more transverse prothorax carinate along the middle, in its carinate beak and much sparser vestiture. In the European species the beak is still more slender, more cylindrical and is generally wholly devoid of carina, though having occasionally a feeble trace, and the pronotum is not carinate as it is in *geminatus*.

**L. oregonus** n. sp.—Somewhat narrow and elongate, moderately convex, black and rather dull, the vestiture nearly as in *geminatus*. Head fully one-half as wide as the prothorax, the fovea small, rounded, deep and perforate; eyes convex and separated by about twice their own width; beak long and slender, very feebly arcuate, much longer than the prothorax and subcylindrical, moderately punctato-rugose, the carina feeble, wholly obsolete toward base; antennæ long and slender, the second funicular joint narrower and almost one-half longer than the first. Prothorax small, only just visibly wider than long, the sides parallel and nearly straight to slightly beyond the middle, then unevenly convergent and sinuate to the apex, which is fully three-fourths as wide as the base; disk coarsely rugose, the median carina narrow and very strongly

elevated. *Elytra* fully one-half longer than wide, twice as wide as the prothorax, gradually narrowed behind, with the sides arcuate behind the middle, the sutural angles individually somewhat acutely and distinctly prominent; humeral angles rounded, transversely exposed at base; disk with series of punctures of varying sizes, the larger nearly one-half as wide as the intervals but rounded, the surface finely and rather feebly punctato-rugose. Length 10.5 mm.; width 4.4 mm.

#### Oregon.

Allied to *geminatus*, but differing in the more elongate form, much smaller and less transverse prothorax, longer and almost non-carinate beak, coarser serial punctures and more prominent sutural angles of the elytra.

**L. perforatus** n. sp.—Elongate, the rugosities polished, black throughout, the vestiture rather dense, consisting of gray or rust-brown slender scales, variegated; especially toward the sides of the elytra, with small and paler spots of dense scales, the oblique vittæ of the pronotum rather narrow but well marked, straight and generally with an external spur at the middle; abdominal spots well developed. *Head* about one-half as wide as the prothorax, densely squamulose, the scales of the beak longer, whiter and hair-like; interocular fovea deep, narrow and fusiform; eyes rather convex, separated by somewhat less than twice their own width; beak long and somewhat stout, longer than the prothorax, straight but bent downward from the point of antennal insertion, the surface roughly punctato-rugose, the carina feeble and subobsolete near the base; antennæ long, the second funicular joint much longer than the first, the seventh transverse. *Prothorax* only slightly wider than long, the sides subparallel, sometimes slightly convergent toward base, rough and uneven, constricted behind the apex, the latter broad, truncate and tubulate; disk rugose, the median carina narrow and strong, disappearing in the median impression at the base. *Elytra* more than one-half longer than wide, generally not quite twice as wide as the prothorax, the sides parallel and broadly rounded, the apex triangular with feebly arcuate sides which are discontinuous with the sides from the umbones to the base, the sutural angles individually angulate and separated by a pronounced notch; disk gradually rounded and declivous behind in profile, the tips explanate, the surface uniformly and finely rugose, the series alternately perceptibly more approximate; serial punctures differing greatly in size and generally widely spaced, the larger very elongate, deep, coarse and perforate. *Legs* long, the femora with a ring of pale scales at apical third as usual. Length 10.3–12.0 mm.; width 4.1–5.25 mm.

British Columbia; Washington State; California (Yreka, Siskiyou Co.)

An abundant species in the northern Pacific coast regions and one of the most strikingly distinct of the genus. Each elytron

has the usual small spot of pale scales before the middle of the disk, but otherwise there is scarcely any resemblance to *geminatus*. Numerous specimens.

### **LISTRONOTUS** Jekel.

The form described below is remarkable in having angulate prominences behind the humeri, which may be homologous with the corresponding protuberances in *Plectromodes*.

**L. scapularis** n. sp.—Parallel and somewhat stout, moderately convex, black, densely clothed throughout with brown scales nearly uniform in color, on the pronotum slightly larger but not obscuring the punctures and slightly paler in a feeble oblique line at each side and in the middle toward base. *Head* a little less than one-half as wide as the prothorax, densely fulvo-squamulose, the eyes separated by nearly four times their own width; beak long, about as long as the head and prothorax, straight, bent downward and gradually dilated toward tip, tricarinate above, squamose and densely punctato-rugose throughout; antennæ long and slender, inserted near the apex, the scrobes long, deep, coarse, straight and horizontal, scape very long, slender, feebly enlarged distally, second joint of the funicle greatly elongate, more than twice as long as the first and almost as long as the next four combined. *Prothorax* two-fifths wider than long, the sides subparallel, conspicuously and almost evenly arcuate, a little more convergent toward apex than base, the former three-fourths as wide as the latter, truncate, the ocular lobes well developed; base broadly arcuate; disk sparsely, moderately coarsely punctate, each puncture bearing a small stiff hair. *Scutellum* circular, densely clothed with pale whitish scales. *Elytra* three-fifths longer than wide, between three and four times as long as the prothorax and nearly one-half wider; sides parallel and straight behind the post-humeral projection, outwardly oblique and straight from the base to the apex of the angulate prominence, gradually rounded in about apical third, the subapical umbones well marked; disk finely striate, the striæ finely, feebly and indistinctly punctate; intervals flat, finely, sparsely punctate, each puncture bearing a small stout hair. *Abdomen* densely squamose on the two basal segments, thence coarsely pubescent with squamose sublateral areas to the apex; legs long, densely squamose and with short stiff sparse hairs, the scales paler toward the femoral apices. Length 12.0 mm.; width 5.0 mm. (across the post-humeral angular prominences 5.5 mm.).

Texas (El Paso). Mr. Dunn.

This large and distinct species may be placed near *callosus* Lec., for the present, but is not closely allied to any other thus far described. The type is probably a female. Two specimens.

**L. tessellatus** n. sp.—Elongate-oval, strongly convex, black, the tibiæ, tarsi and antennæ rufo-piceous; scales very dense, rounded and with radiating strigosity, only slightly larger on the pronotum but more distinct, cinereous-



white in color with two large transverse areas of black at the base of the pronotum and two smaller and feebler at the middle, the elytra with numerous isolated or partially anastomosing black spots throughout the extent; head densely, the beak more sparsely clothed with short narrow squamules. *Head* three-fifths as wide as the prothorax, without a fovea but with a rounded spot of pale scales between the eyes, the latter remotely separated; beak short and stout, not as long as the prothorax, bent downward and feebly dilated toward tip, finely, densely, rugosely punctate, with a single fine and feeble dorsal carinula; antennæ rather short and thick, inserted at outer third or fourth, the second funicular joint not quite twice as long as the first and but slightly longer than the next three, the third longer than the fourth. *Prothorax* small, slightly wider than long, the sides arcuate; apex truncate, more than three-fourths as wide as the base, which is but feebly arcuato-truncate; ocular lobes moderately developed; disk evenly convex, finely, sparsely punctate, each puncture with a small suberect stout hair. *Scutellum* small, not conspicuous. *Elytra* one-half longer than wide, scarcely three times as long as the prothorax and one-half to nearly two-thirds wider, parallel and straight at the sides, gradually obtusely rounded behind, humeri rounded to the prothorax, exposed at base; subapical umbones obsolete; disk finely striate, the striae very finely, scarcely distinctly punctate, the intervals feebly convex, finely, sparsely punctate, each puncture bearing a stout erect and strigilate hair. *Abdomen* thinly clothed with short stout hairs, squamose toward the sides, strongly and closely punctate; legs moderately long, the femora more densely squamose and swollen distally but narrowed near the tip; hairs short, erect and sparse. Length 5.3–6.5 mm.; width 2.25–2.85 mm.

Colorado (Denver). Mr. Hugo Soltan.

A small but distinct species, quite conspicuous in maculation; it was taken by Mr. Soltan in considerable numbers. It may be placed near *rotundicollis* in the arrangement recently proposed by LeConte (Proc. Am. Phil. Soc., XV, p. 128.)

#### **PLECTROMODES** n. gen. (Phytonomini).

Body oval, very convex and sparsely pubescent, the elytra acutely prominent at the sides behind the humeri. Head subglobular, moderately inserted, the eyes scarcely convex, transverse, distant from the base, somewhat coarsely faceted, moderately separated above, remotely so beneath, truncate anteriorly, gradually obtusely pointed beneath. Beak short, thick, cylindrical, feebly dilated toward apex, the scrobes extending almost to the tip, becoming partially visible from above, obliquely descending toward base and terminating at the lower angle of the eye. Antennæ inserted near the apex of the beak, the scape slender, extending to the base, enlarged at apex; basal joint of the funicle



elongate, the second less elongate, three to seven short, gradually wider, the club thick, oval, densely pubescent and four-jointed. Mandibles stout, emarginate and bidentate at apex, the lower lobe the longer and larger. Mentum trapezoidal, rather longer than wide, not concealing the maxillary cardo; gular peduncle long, narrowed at base. Prothorax without ocular lobes. Anterior coxæ large, prominent, contiguous, the prosternum before them short, sinuate and unimpressed; middle coxæ narrowly separated, the posterior also apparently rather approximate. Abdomen flat, the two basal segments each as long as the third and fourth together, the dividing suture moderately coarse and broadly angulate; fifth rounded and nearly as long as the two preceding together; posterior sutures coarse and straight. Legs well developed, the femora not clavate, with a small erect denticle beneath beyond the middle; tibiæ stout, longitudinally fluted, denticulate within near the middle, the apex obliquely truncate with a double outer edge and a strong internally projecting terminal spur; tarsi stout, densely pubescent beneath, the first three joints rather short, the last long; claws stout, completely connate in more than basal half.

This singular genus is assigned to the Phytonomini only provisionally and for convenience, for it probably represents a distinct though closely allied tribe. The peculiar dentiform prominence at the sides of the elytra behind the base is suggested in a species of *Listronotus*, described above in order to bring out this character, and the beak with its scrobes and the formation of the prosternum are all strongly suggestive of that genus.

The two species before me may be distinguished as follows:—

Body stout, the elytra with two apical areas of dense pubescence, the prominences at the summit of the declivity also densely pubescent.

**paludatus**

Body much smaller and less robust, the elytra without the apical pubescent areas, the prominences at the summit of the declivity not pronounced and scarcely more densely pubescent.....**armatus**

The genus *Plectromodes* is probably confined to the United States east of the Rocky Mountains, extending into the northern parts of the Sonoran province, but not forming an element of the tropical Mexican fauna.

**P. paludatus** n. sp.—Broadly oval, strongly convex, black and polished throughout; pubescence consisting of sparse suberect white hairs, moderate in

length, distinct and abundant on the pronotum, very sparse on the elytra but denser in a transverse region near basal third, much longer near the sides, in two spots near apical third and in two apical areas. *Head* distinctly less than one-half as wide as the prothorax, subglobular, broader at base, strongly and densely punctate, without interocular fovea, the eyes separated by a little less than their own width; beak thick, parallel, subcylindrical, nearly straight, three-fourths as long as the prothorax, feebly and gradually subdilated at apex, strongly, closely punctate, somewhat rugose at the sides, not at all carinate above; antennæ rather thick, the basal joint of the funicle almost as long as the next three. *Prothorax* one-fourth wider than long, the sides subparallel and feebly arcuate to apical two-fifths, there minutely, angularly subtuberculate, thence strongly convergent and nearly straight to the apex, the latter arcuate and one-half as wide as the base, which is transverse and feebly lobed in the middle; disk strongly convex, strongly, deeply and very densely punctate, devoid of all trace of a modified median line. *Scutellum* small, rounded. *Elytra* exclusive of the post-humeral prominences, one-fifth longer than wide and fully two-fifths wider than the prothorax, strongly declivous behind in profile from just behind the middle; apex evenly rounded; humeri rounded and scarcely tumid; disk with feebly impressed series of coarse rounded punctures, the intervals polished, sparsely and scarcely visibly punctulate. *Abdomen* strongly but rather sparsely punctate, feebly pubescent; legs strongly sculptured and sparsely, coarsely pubescent. Length 5.0–6.8 mm.; width 2.7–3.7 mm.

#### Arizona.

Widely distributed in American collections under the name *Chalcodermus spinifer* Boh. It however does not agree in any way with the description of that species, and is not at all related to *Chalcodermus*. Four specimens.

**P. armatus** n. sp.—Less broadly oval, strongly convex, black, strongly shining, the antennæ dark rufous with the club darker; pubescence very short, whitish, sparse and inconspicuous, intermingled on the elytra with a few longer erect and coarse hairs of the same color disposed for the most part in single series along the intervals but more numerous at the summit of the apical declivity. *Head* scarcely two-fifths as wide as the prothorax, convex, strongly, closely punctate, the eyes separated by nearly their own width; beak short and stout, scarcely three-fourths as long as the prothorax, the upper surface strongly, unevenly and not very densely punctate, not carinate and longitudinally arcuate in profile, gradually and feebly dilated at apex; antennæ rather slender, inserted at apical fourth, the basal joint of the funicle not quite as long as the next three. *Prothorax* distinctly wider than long, the sides subparallel, rather unevenly arcuate, more convergent near the apex, minutely subprominent at apical two-fifths; apex arcuate, fully one-half as wide as the base; disk coarsely, deeply and very densely punctate, evenly convex and without a modified median line. *Elytra* distinctly longer than wide, much less than twice as long as the prothorax and scarcely one-fourth wider, the

humeri narrowly rounded to the prothorax and scarcely tumid, the post-humeral spiniform prominences strongly developed; apex rather narrowly rounded; disk strongly declivous behind from near the middle at an angle of forty-five degrees in profile, with series of very coarse deep rounded punctures separated by polished intervals. *Legs* moderately coarsely sculptured and clothed sparsely with short silvery hairs. Length 4.0-4.8 mm.; width 2.0-2.6 mm.

Southern Illinois.

This species is much smaller and narrower than *paludatus*, and has the vestiture still shorter and sparser but more evenly distributed. Two specimens.

The elytra have well marked but narrow epipleuræ, extending with equal width from beneath the post-humeral prominences to the sutural angles. The met-episterna are narrow, with the suture well marked and the metasternum is rather longer than the first ventral.

#### **RYSSEMATUS** Chev.

The somewhat numerous representatives of this genus may be separated into two tolerably well defined subgenera, as shown by the following tabular statement:—

*Alternate intervals of the elytra carinate.*

#### **Ryssematus** in sp.

Elytra unicolorous throughout and generally black, subglabrous or with the minute hairs only moderately conspicuous and evenly distributed.

Elytral carinæ more strongly developed; species larger.

Prothorax slightly inflated behind, the sides becoming parallel toward base.

Elytra dull, the serial punctures narrow, elongate and widely spaced, becoming linear and very feeble toward apex, the carinæ only moderately elevated.....**grandicollis** n. sp.

Elytra rather shining, the serial punctures coarse and somewhat close-set, distinct to the apex, the carinæ very strongly elevated.

#### **lineaticollis** Say

Prothorax not inflated, the sides divergent to the base and never parallel; pronotal rugæ coarse and converging posteriorly toward the middle; body much smaller and narrower, the prothorax relatively smaller and more conical.....**annectens** n. sp.

Elytral carinæ very feeble, the flat intervals rugose; pronotal rugæ coarse and strongly oblique; minute hairs of the elytra quite numerous and distinct; small species .....**æqualis** Horn

Elytra pale or mottled, always distinctly pubescent.

Elytra in great part blackish, with small feeble rufescent markings to which the unevenly distributed pubescence is principally confined.

Intermediate intervals of the elytra not at all carinate; pronotal rugæ long and oblique .....**palmacollis** Say

Intermediate intervals feebly and incompletely carinate; pronotal rugæ less oblique .....**medialis** n. sp.

Elytra in great part pale, the pubescence longer, more evenly distributed and very conspicuous; pronotal rugæ oblique.....**pubescens** Horn

*Alternate intervals not at all carinate.*

**Sermysatus** n. sg.

Eyes rather narrowly separated on the front.....**pruinus** Boh.

Eyes widely separated, the beak less elongate and less slender.

Body rather broadly oval, the abdomen distinctly punctate.....**ovalis** Csy.

Body narrowly oval and much smaller, paler in color, the abdomen only slightly punctate.....**parvulus** n. sp.

In the United States the genus *Ryssematus* is confined to the eastern faunal regions, extending into the Sonoran province. No species is known to occur within the true Pacific coast region.

**R. grandicollis.**—Broadly oval and very convex, deep black throughout, the antennæ and tarsi only slightly piceous; setæ along the elytral ridges very minute and inconspicuous. *Head* scarcely one-third as wide as the prothorax, deeply, densely punctate and with short fulvous hairs, the eyes large, broadly sinuato-truncate anteriorly and margined with a deep groove behind, rather narrowly separated on the front; beak thick, as long as the head and prothorax, feebly arcuate, slightly thinner and somewhat bent near the apex, strongly carinate above from the interocular fovea to the antennæ, finely, rather sparsely punctate toward apex, longitudinally rugose, dull and more densely punctate thence to the base especially at the sides; antennæ inserted just beyond the middle, the basal joint of the funicle about as long as the next two. *Prothorax* large, about twice as wide as long, strongly rounded at the sides, the latter becoming parallel and arcuate in about basal third, strongly convergent anteriorly; apex arcuate and distinctly less than one-half as wide as the base, the latter transverse; disk closely, longitudinally rugose, the rugæ much disintegrated at the sides and on the flanks beneath, becoming much confused, more feeble and somewhat dull, the feeble apical constriction more coarsely and deeply sculptured as usual. *Elytra* distinctly longer than wide, only very slightly wider than the prothorax, the sides slightly convergent and feebly arcuate from the large and moderately prominent humeral protuberances to the apex, the latter somewhat narrowly rounded; disk very dull, the obtuse crests of the feebly elevated carinæ alone polished; punctures rather shallow, elongate and distant, connected by fine, scarcely impressed but more shining lines and becoming very small toward apex. *Abdomen* coarsely punctate at base, thence finely, rather densely so to the fifth segment, which is very

densely and somewhat finely punctate, the legs stout with the femoral tooth large. Length 6.7 mm.; width 3.7 mm.

Iowa (Keokuk).

Readily distinguishable from *lineaticollis* by its stouter form, still larger and more inflated prothorax which is much more feebly and indefinitely rugose at the sides beneath, and by the peculiar feeble elytral sculpture. The single type before me is apparently a male, but the fifth ventral is scarcely perceptibly modified on the disk.

**R. annectens.**—Narrowly oval, somewhat shining, black, the tarsi and antennæ rufous, the club of the latter infusate; minute elytral setæ entirely inconspicuous. *Head* rather more than one-third as wide as the prothorax, somewhat finely and densely punctate, fulvo-pubescent; eyes narrowly separated on the front, broadly sinuato-truncate anteriorly; beak almost as long as the head and prothorax, nearly straight, feebly and obliquely flattened distally, finely and sparsely punctate toward apex, thence more obviously sculptured and punctate in longitudinal eroded rugæ to the base; dorsal carina moderately developed, the interocular fovea small; antennæ inserted quite distinctly beyond the middle. *Prothorax* small, nearly twice as wide as long, feebly constricted at the apex, the latter one-half as wide as the base; sides strongly, evenly convergent and feebly arcuate from base to apex; disk coarsely plicato-rugose, the rugæ sinuous and quite uneven, inwardly and posteriorly oblique toward the middle, moderately disintegrated and with the lustre duller on the flanks beneath. *Elytra* distinctly longer than wide, nearly one-third wider than the prothorax and about three times as long; outline oval, the humeral convexities feeble; carinæ moderately strong, the intervals alutaceous and nearly smooth, the serial punctures deep, somewhat elongato-subquadrate and separated by about their own lengths, distinct to the apex. *Abdomen* very densely punctate throughout, more coarsely so at base. Length 4.8–5.0 mm.; width 2.6 mm.

Indiana?

Two specimens from the Levette cabinet without labels, but probably taken in or near the above region. This species cannot be confounded with any other, for, with a general facies suggestive of *lineaticollis*, it has the oblique pronotal rugæ of *palma-collis* and some other pubescent species. The prothorax is very much smaller than in any other species of the *lineaticollis* group of the genus. The types are probably males.

**R. medialis.**—Subrhomboid-oval, strongly convex, rather shining, dark rufo-piceous, the legs and upper surface somewhat darker, the elytra with small indefinite paler areas especially toward apex; pubescence sparse, evenly distributed and consisting of short erect yellowish setæ on the prothorax, on

the elytra uneven and denser on the small pale areas. *Head* more than one-third as wide as the prothorax, coarsely, densely sculptured, not very densely fulvo-pubescent; eyes large, very coarsely faceted and almost contiguous on the front; beak rather long and slender, feebly arcuate, nearly one-half as long as the body, cylindrical, shining and finely, distinctly punctate toward apex, dull, longitudinally and feebly rugose and not distinctly punctate toward base, the dorsal carina almost obsolete except toward base; antennæ inserted distinctly behind the middle, the basal joint of the funicle as long as the next two. *Prothorax* small, rapidly conical, nearly twice as wide as long, the sides strongly convergent from the base and only just visibly arcuate; disk with fine, strongly elevated and anastomosing rugæ, which are rather widely distant and inwardly oblique posteriorly, the median carina fine and distinct, the rugæ feebler, closer and less defined on the flanks beneath. *Elytra* from above one-fourth longer than wide, one-fourth wider than the prothorax and not quite three times as long, the carinæ rather broad and moderately elevated, the intermediate intervals also obsoletely carinate, the serial punctures moderately coarse and close-set, slightly elongate and distinct to the apex. *Abdomen* shining, feebly and not very closely punctate, rather densely so however on the fifth segment; metasternum coarsely but somewhat sparsely punctured; legs moderate, the femoral tooth well developed. Length 4.2 mm.; width 2.3 mm.

— Arizona (Tucson). Mr. Wickham.

This is a distinct species, readily distinguishable from any other by the subcarinate intermediate intervals of the elytra; the eyes are even more approximate than in the *lineaticollis* group.

There are before me two specimens which I refer to *pubescens* Horn; one of them is from an unknown part of Arizona, and the other from San Augustine, New Mexico, collected by Mr. Cockrell; there are some slight differences between them but both satisfy the description sufficiently well; the alternate elytral intervals are flat, and the eyes are less approximate than in *medialis*.

**R. parvulus.**—Narrowly oval, very convex, strongly shining, pale rufo-testaceous throughout, glabrous. *Head* nearly two-fifths as wide as the prothorax, rather sparsely punctured; eyes in considerable part covered by the ocular lobes in repose, widely separated on the front, the interocular fovea distinct; beak rather slender, cylindrical, evenly and feebly arcuate, longer than the head and prothorax, shining, finely but distinctly, sparsely punctate, not at all carinate above toward base; antennæ slender, inserted at about the middle, the basal joint of the funicle elongate as usual, club long and narrow, pointed. *Prothorax* fully three-fourths wider than long, feebly constricted near the apex, the latter nearly one-half as wide as the base; sides strongly convergent and broadly, evenly arcuate from the base; disk strongly and

somewhat closely punctate, with a narrow and incomplete median impunctate line, the sculpture becoming gradually longitudinally rugose at the sides and more feebly so beneath. Scutellum small, rounded. *Elytra* oval, obtusely rounded behind, distinctly longer than wide, slightly wider than the prothorax, the humeral protuberances small and very feeble; disk coarsely, evenly striate, the striæ widely and deeply impressed, strongly and not very closely punctate, the convex intervals sparsely punctulate and somewhat unevenly creased, becoming subcariniform toward the sides and apex. *Abdomen* polished, scarcely at all punctate, the fifth ventral with scattered punctures; legs rather short, not strongly sculptured, the femoral tooth distinct. Length 2.8-3.0 mm.; width 1.5 mm.

New Mexico (San Augustine). Mr. Cockerell.

This species is the smallest of the genus known to me, and is allied rather closely to *ovalis*, being distinguishable by its much narrower form, paler coloration, less punctate abdomen, relatively less finely and densely sculptured pronotum and other features.

Of the three specimens before me, one has a deep and smooth circular pit at the middle of the fifth ventral, the other two having only a shallow and feebly defined impression at the same point. It is possible that the first may be the male, but I can discover no other differences, either in the form of the body or structure of the beak.

#### **PARACAMPTUS** n. gen.

Body narrowly oval, convex, the pronotum projecting anteriorly and concealing the head, the met-episterna distinct; epimera not visible, the suture if present concealed by the dense indument. Head deeply inserted, the eyes small, coarsely faceted, widely separated and not concealed in repose, the ocular lobes feebly developed. Beak short, parallel, narrow and nearly straight, completely concealed in repose in a deep excavation extending far into the mesosternum; scrobes short, deep, lateral, attaining the lower angle of the eyes. Antennæ with the scape short, the funicle slender, seven-jointed, the basal joint, and the second less strongly, elongate, the seventh wider, obconical and more pubescent; club oval, compressed, annulate toward apex, the basal joint large and pubescent throughout. Coxæ all widely separated, the posterior remote, attaining the met-episterna. Metasternum elongate. Abdomen with the first two segments long, separated by a fine and feebly arcuate suture; third and fourth short, the fifth nearly as long as the two preceding, rounded at apex, the

last three sutures straight and very coarse. Legs short, the femora elongate, parallel and completely unarmed, the tibiæ extremely short, not more than one-half as long as the femora, terminated by a strong curved spur projecting sublongitudinally from the outer angle; tarsi as long as the tibiæ, the third joint dilated and bilobed; last joint slender; claws rather short, very stout, simple, strongly arcuate and divergent. Elytra with the side margins horizontally inflexed around the apices but vertical toward base.

In general habitus this genus strongly resembles *Acamptus*, but its structural characters place it in the vicinity of *Lembodes*; it is represented at present by a single species.

**P. subtropicus** n. sp.—Strongly convex, black, densely covered throughout the body and legs with a thick grayish crust of cottony or felted consistence, from which arise sparse subclavate scales, which are distinct on the prothorax, but, on the elytra, very short and only distinct on the elevated intervals, the indument subdenuded in an elongate blackish spot behind the scutellum. *Head* two-fifths as wide as the prothorax, densely clothed with the squamiferous indument in a crust which continues onto the base of the beak, the latter three-fourths as long as the prothorax, piceous, shining, nude and punctate, parallel and slender but rapidly broadening at base. *Prothorax* as long as wide, narrowed and sinuate at the sides toward apex, the latter strongly, evenly rounded; sides becoming parallel toward base, the latter rectilinear; disk almost even. *Scutellum* small, acutely elevated. *Elytra* one-third longer than wide, distinctly wider than the prothorax and scarcely twice as long; sides parallel and nearly straight, the apex broadly rounded; humeral angles very slightly tumid; disk finely striate, not distinctly punctate, the alternate intervals strongly elevated but nearly flat. Length 2.2–3.0 mm.; width 0.8–1.25 mm.

Florida (Punta Gorda). Mr. Schwarz.

The indument is usually a little darker on the prothorax, with a fine median line and broader lateral stripe paler, and the elytra have a transverse series of small feeble darker spots before the middle and one or two on the suture toward apex.

Note.—It is probable that *Acamptus echinus*, recently described by me (Col. Not. IV, p. 445) from New York, is in reality from Arizona, the label being erroneous.

#### **ACALLES** Schönh.

The following species belongs near *hubbardi* Lec., and is still broader across the humeral tuberosities:—



**A. dilatatus** n. sp.—Stout, the elytra very abruptly dilated behind the base, black throughout; pronotum with some velvety-black scales before the middle and near the apex; elytra with the patches of white scales disposed nearly as in *hubbardi*, the scales of the third interval in the posterior band more prolonged anteriorly; each of the large foveæ with a broad whitish scale. *Head* finely, strongly punctate and squamose, more than one-third as wide as the prothorax, the interocular fovea extremely large and deep; beak stout, dull, squamose at base, finely but strongly, not very closely punctate. *Prothorax* slightly wider than long, strongly rounded at the sides, narrowed at base and still more strongly toward apex, the latter one-half as wide as the base; disk coarsely and closely punctate, the punctures coarser and more confluent toward base; median carina strong at the middle, not attaining the base. *Elytra* not as long as wide from above, twice as long and twice as wide as the prothorax, the post-humeral protuberancies extremely developed, their oblique anterior sides deeply emarginate midway to the base; sides strongly convergent and rounded behind the tubercles, the apex obtuse; disk deeply perpendicular behind in profile, having deep series of very large contiguous subtransverse foveæ, the series separated by strong tuberculiferous ridges, the humeral ridge most pronounced. *Abdomen* sparsely punctate and squamose; legs densely and unevenly clothed with scales. Length 8.0 mm.; width 5.6 mm.

Florida. Mr. Jülich.

The single specimen in my cabinet, which was probably taken in the extreme southern part of the State, represents a close ally of *hubbardi*, differing in the greater development of the post-humeral tubercles and consequently much stouter form of the body, but more particularly in the very close and roughly tuberculose sculpture, deeper and less elongate frontal fovea and other characters. The elytral foveæ are so closely crowded that they coalesce, producing deep broad furrows between the ridge-like intervals, while in *hubbardi* the foveæ are isolated and rounded.

# ANNALS

## OF THE

### NEW YORK ACADEMY OF SCIENCES.

The "ANNALS," published for over half a century by the Lyceum of Natural History, are continued under the above name by the New York Academy of Sciences, beginning in 1877. Seven volumes of the new series have now been issued.

With the beginning of the fourth volume, the Academy decided to change somewhat the mode of publication. The ANNALS are henceforth issued without particular reference to times or periods. The parts will appear as material for them shall be offered; each single part, or number, as before, will contain at least 32 pages, with or without plates; twelve numbers, as before, whenever published, will constitute a volume. The size and general character of the parts and volumes will not be changed; nor is it intended at all to reduce the average yearly amount of matter.

The ANNALS include the more extended and elaborate papers laid before the Academy. The briefer papers and discussions that form part of the Academy's meetings appear in its other publication, the TRANSACTIONS, which it is designed to issue promptly and regularly, so as to give a record of the current work of each year,—the single numbers appearing monthly (or double, bi-monthly), and eight single numbers forming an annual volume.

By vote of the Academy, both these publications will be sent FREE to its Resident and Honorary members. To non-resident members the price of the TRANSACTIONS will be \$3.00 per year.

To all others, prices will be as follows:

|  |               |
|--|---------------|
| Annals, single numbers, . . . . .            | Fifty cents.  |
| “ double or multiple numbers, in proportion. |               |
| “ per volume (12 numbers), . . . . .         | Six Dollars.  |
| Transactions, per year, . . . . .            | Five Dollars. |

All communications should be addressed to

J. F. KEMP,  
*Columbia College, New York.*

The Academy has for sale a number of back volumes of the ANNALS of both series, each containing twelve or more numbers; the price per volume is Five Dollars in the old (Lyceum) series, and Six Dollars in the new (Academy) series.

## CONTENTS.

PAGE

- XI.—The Parallax of  $\eta$  Cassiopeiæ, deduced from Rutherford  
Photographic Measures. By HERMAN S. DAVIS, . . . . . 301
- XII.—On Certain Bacteria from the Air of New York City. By  
HARRISON G. DYAR, . . . . . 322
- XIII.—The Rutherford Photographic Measures of Sixty-two Stars  
about  $\eta$  Cassiopeiæ. By HERMAN S. DAVIS, . . . . . 381
- XIV.—The Arachnida of Colorado. By NATHAN BANKS, . . . . . 417
- XV.—Coleopterological Notices, VI. By THOS. L. CASEY, . . . . 435

## GENERAL INDEX.

The names of groups higher than genera are in SMALL CAPITALS; names of synonyms and of species assigned to erroneous genera are in *italics*. References to the lists constituting papers IX, X, XII and XIV are restricted to generic and higher group names.

|                                 | PAGE     |                                | PAGE     |
|---------------------------------|----------|--------------------------------|----------|
| Acalles . . . . .               | 837      | Ancistrus . . . . .            | 256      |
| <i>dilatatus</i> . . . . .      | 838      | Anistomus . . . . .            | 261      |
| ACARINA . . . . .               | 432      | ANTHICIDÆ . . . . .            | 624      |
| Achatodes zœ . . . . .          | 225      | ANTHICINÆ . . . . .            | 625      |
| Aconobius . . . . .             | 617      | ANTHICINI . . . . .            | 626, 639 |
| Acronycta . . . . .             | 226      | Anthicus . . . . .             | 641, 686 |
| Adaleres . . . . .              | 810, 816 | <i>agilis</i> . . . . .        | 691, 726 |
| <i>humeralis</i> . . . . .      | 816, 818 | <i>amœnus</i> . . . . .        | 690, 722 |
| <i>ovipennis</i> . . . . .      | 816      | <i>amplicollis</i> . . . . .   | 731      |
| Adasytes . . . . .              | 458, 539 | <i>ancilla</i> . . . . .       | 689, 711 |
| <i>laciniatus</i> . . . . .     | 540      | <i>atomarius</i> . . . . .     | 731      |
| Adoneta spinuloides . . . . .   | 213      | <i>auriger</i> . . . . .       | 689, 714 |
| AGALENIDÆ . . . . .             | 422      | <i>bellulus</i> . . . . .      | 690, 724 |
| AGARISTIDÆ . . . . .            | 226      | <i>bifasciatus</i> . . . . .   | 676      |
| Ageneiosus . . . . .            | 252      | <i>biguttulus</i> . . . . .    | 688, 700 |
| Allonyx . . . . .               | 459, 588 | <i>cæsiosignatus</i> . . . . . | 731      |
| <i>denudatus</i> . . . . .      | 589, 590 | <i>cephalotes</i> . . . . .    | 689, 705 |
| <i>disjunctus</i> . . . . .     | 589, 590 | <i>cervinus</i> . . . . .      | 689, 708 |
| <i>sculptilis</i> . . . . .     | 589      | <i>compositus</i> . . . . .    | 688, 698 |
| Alloporus bipunctatus . . . . . | 27       | <i>confusus</i> . . . . .      | 694      |
| Alymeris . . . . .              | 600      | <i>convexulus</i> . . . . .    | 691, 729 |
| <i>basalis</i> . . . . .        | 600      | <i>coracinus</i> . . . . .     | 688, 704 |
| <i>cribrata</i> . . . . .       | 600, 601 | <i>cribratus</i> . . . . .     | 687, 692 |
| <i>floridana</i> . . . . .      | 600, 601 | <i>decorellus</i> . . . . .    | 690, 717 |
| Alypia octomaculata . . . . .   | 226      | <i>decrepitus</i> . . . . .    | 689, 707 |
| Amblyderus . . . . .            | 641, 742 | <i>difficilis</i> . . . . .    | 694      |
| <i>albicans</i> . . . . .       | 742, 744 | <i>ephippium</i> . . . . .     | 687, 694 |
| <i>arenarius</i> . . . . .      | 742, 748 | <i>exilis</i> . . . . .        | 731      |
| <i>gracilentus</i> . . . . .    | 742, 745 | <i>facilis</i> . . . . .       | 728      |
| <i>granularis</i> . . . . .     | 742, 746 | <i>flavicans</i> . . . . .     | 688, 697 |
| <i>obesus</i> . . . . .         | 742, 743 | <i>gilensis</i> . . . . .      | 689, 709 |
| <i>pallens</i> . . . . .        | 742, 747 | <i>haldemani</i> . . . . .     | 689, 713 |
| <i>parviceps</i> . . . . .      | 742, 744 | <i>hastatus</i> . . . . .      | 688, 701 |
| <i>punctiger</i> . . . . .      | 742, 747 | <i>hecate</i> . . . . .        | 687, 693 |
| Amnesia . . . . .               | 810, 813 | <i>helvinus</i> . . . . .      | 690, 725 |
| <i>debilis</i> . . . . .        | 815      | <i>herifuga</i> . . . . .      | 691, 726 |
| <i>discors</i> . . . . .        | 814      | <i>heroicus</i> . . . . .      | 689, 712 |
| <i>tumida</i> . . . . .         | 813      | <i>horridus</i> . . . . .      | 687, 691 |
| Anacyrtus . . . . .             | 295      | <i>ietericus</i> . . . . .     | 691, 728 |

|  | PAGE     |  | PAGE     |
|--|----------|--|----------|
| <i>Anthicus impressipennis</i> . . . . . | 731      | <i>Axylophilus</i> . . . . .           | 774, 808 |
| <i>innocens</i> . . . . .                | 690, 721 | <i>yuccæ</i> . . . . .                 | 809      |
| <i>inseitus</i> . . . . .                | 690, 721 | <i>Bacillus</i> . . . . .              | 356-379  |
| <i>junctus</i> . . . . .                 | 690, 716 | <i>Bacteria</i> . . . . .              | 322      |
| <i>latebrans</i> . . . . .               | 728      | classification of . . . . .            | 345      |
| <i>lecontei</i> . . . . .                | 730      | species among . . . . .                | 323      |
| <i>luteolus</i> . . . . .                | 688, 695 | variation in . . . . .                 | 327      |
| <i>lutulentus</i> . . . . .              | 691, 725 | <i>Baulius</i> . . . . .               | 641, 650 |
| <i>maritimus</i> . . . . .               | 691, 729 | <i>tenuis</i> . . . . .                | 651      |
| <i>melancholicus</i> . . . . .           | 691, 728 | <i>BDELLIDÆ</i> . . . . .              | 433      |
| <i>mercurialis</i> . . . . .             | 689, 707 | <i>BLAPSTINI</i> . . . . .             | 615      |
| <i>militaris</i> . . . . .               | 690, 724 | <i>BOLITOPHAGINI</i> . . . . .         | 623      |
| <i>monticola</i> . . . . .               | 689, 705 | <i>Bombycine</i> moths . . . . .       | 41       |
| <i>mundus</i> . . . . .                  | 691, 727 | <i>Botrodes</i> . . . . .              | 453      |
| <i>nanus</i> . . . . .                   | 690, 717 | <i>Byturosomus</i> . . . . .           | 466      |
| <i>nigrita</i> . . . . .                 | 688, 699 | <i>Cacœcia cerasivorana</i> . . . . .  | 208      |
| <i>nitidus</i> . . . . .                 | 731      | <i>Cænotropus</i> . . . . .            | 260      |
| <i>nympha</i> . . . . .                  | 690, 719 | <i>CALLICHTHIDÆ</i> . . . . .          | 256      |
| <i>obliquus</i> . . . . .                | 690, 720 | <i>Callichthys</i> . . . . .           | 256      |
| <i>obscurellus</i> . . . . .             | 690, 723 | <i>Calocalpe undulata</i> . . . . .    | 227      |
| <i>ovicollis</i> . . . . .               | 688, 699 | <i>Carpocapsa pomonella</i> . . . . .  | 208      |
| <i>pallidus</i> . . . . .                | 731      | Catfishes, S. Amer. . . . .            | 249      |
| <i>parallelus</i> . . . . .              | 689, 710 | <i>Chalceus</i> . . . . .              | 294      |
| <i>peninsularis</i> . . . . .            | 690, 719 | <i>Chalcinus</i> . . . . .             | 294      |
| <i>pinguescens</i> . . . . .             | 688, 696 | <i>CHARACINIDÆ</i> , S. Amer. . . . .  | 257      |
| <i>politus</i> . . . . .                 | 731      | <i>Cheirodon</i> . . . . .             | 288      |
| <i>præceps</i> . . . . .                 | 689, 709 | <i>Chilodus</i> . . . . .              | 260      |
| <i>protectus</i> . . . . .               | 688, 702 | <i>Cicinnus melsheimeri</i> . . . . .  | 210      |
| <i>punctulatus</i> . . . . .             | 689, 706 | <i>Clisiocampa pluvialis</i> . . . . . | 229      |
| <i>rufulus</i> . . . . .                 | 687, 692 | <i>CLUBIONIDÆ</i> . . . . .            | 422      |
| <i>saucius</i> . . . . .                 | 689, 715 | <i>Cnopus</i> . . . . .                | 774, 802 |
| <i>scabriceps</i> . . . . .              | 688, 698 | <i>impressus</i> . . . . .             | 803      |
| <i>seminotatus</i> . . . . .             | 689, 710 | <i>COSSIDÆ</i> . . . . .               | 91, 206  |
| <i>simiolus</i> . . . . .                | 687, 694 | <i>Coehliodon</i> . . . . .            | 256      |
| <i>sodalis</i> . . . . .                 | 689, 712 | <i>Cœlocnemis sulcata</i> . . . . .    | 615      |
| <i>solidus</i> . . . . .                 | 688, 703 | <i>Cœlus</i> . . . . .                 | 611      |
| <i>spretus</i> . . . . .                 | 728      | <i>curtulus</i> . . . . .              | 612      |
| <i>squamosus</i> . . . . .               | 730      | <i>latus</i> . . . . .                 | 612      |
| <i>stellatus</i> . . . . .               | 689, 714 | <i>Conibius</i> . . . . .              | 617      |
| <i>subcalvus</i> . . . . .               | 688, 703 | <i>Coniontis farallonica</i> . . . . . | 610      |
| <i>troglydites</i> . . . . .             | 731      | <i>globulina</i> . . . . .             | 610      |
| <i>vagans</i> . . . . .                  | 690, 718 | <i>Conisattus rectus</i> . . . . .     | 614      |
| <i>vulneratus</i> . . . . .              | 689, 715 | <i>Conosoma</i> . . . . .              | 436      |
| <i>Antispila nysæfoliella</i> . . . . .  | 209      | <i>basalis</i> . . . . .               | 437, 444 |
| <i>Aphyocarax</i> . . . . .              | 291      | <i>bipustulata</i> . . . . .           | 437, 444 |
| <i>Apoda Y-inversa</i> . . . . .         | 221      | <i>bisignata</i> . . . . .             | 444      |
| <i>ARACHNIDA</i> . . . . .               | 417      | <i>castanea</i> . . . . .              | 437, 442 |
| <i>ARCTIIDÆ</i> . . . . .                | 65, 228  | <i>cinctula</i> . . . . .              | 439      |
| <i>Ariotus</i> . . . . .                 | 773, 788 | <i>corticola</i> . . . . .             | 439      |
| <i>quercicola</i> . . . . .              | 788      | <i>crassa</i> . . . . .                | 437, 446 |
| <i>subtropicus</i> . . . . .             | 788, 789 | <i>debilis</i> . . . . .               | 437, 447 |
| <i>Aromatic series</i> . . . . .         | 171      | <i>imbricata</i> . . . . .             | 437, 439 |
| <i>Artace punctistriga</i> . . . . .     | 230      | <i>knoxii</i> . . . . .                | 436, 438 |
| <i>Astyanax</i> . . . . .                | 262      | <i>limuloides</i> . . . . .            | 437, 441 |
| <i>Asydates</i> . . . . .                | 458, 464 | <i>littorea</i> . . . . .              | 436, 438 |
| <i>explanatus</i> . . . . .              | 464, 465 | <i>macer</i> . . . . .                 | 437, 443 |
| <i>rufiventris</i> . . . . .             | 464      |  |          |
| <i>ATTIDÆ</i> . . . . .                  | 430      |  |          |

|   | PAGE     |  | PAGE     |
|---|----------|--|----------|
| <i>Conosoma macsta</i> . . . . .        | 446      | DICTYNIDÆ . . . . .                      | 422      |
| <i>occulta</i> . . . . .                | 437, 446 | <i>Dilandius</i> . . . . .               | 640, 642 |
| <i>opica</i> . . . . .                  | 436, 439 | <i>myrmecops</i> . . . . .               | 642, 643 |
| <i>parvula</i> . . . . .                | 437, 449 | <i>unicus</i> . . . . .                  | 642, 643 |
| <i>pulicaria</i> . . . . .              | 444      | DORADINÆ . . . . .                       | 250      |
| <i>scripta</i> . . . . .                | 437, 449 | <i>Doras</i> . . . . .                   | 251      |
| <i>setifer</i> . . . . .                | 444      | <i>Dolichosoma</i> . . . . .             | 459, 597 |
| <i>subtilis</i> . . . . .               | 437, 448 | <i>foveicollis</i> . . . . .             | 598      |
| <i>velocipes</i> . . . . .              | 437, 442 | <i>nigricornis</i> . . . . .             | 568      |
| <i>versicolor</i> . . . . .             | 437, 447 | <i>tenuiformis</i> . . . . .             | 598, 599 |
| <i>virginia</i> . . . . .               | 437, 443 | <i>Dryopteris rosea</i> . . . . .        | 45       |
| <i>Cradytes</i> . . . . .               | 458, 533 | DREPANIDÆ . . . . .                      | 227      |
| <i>longicollis</i> . . . . .            | 533, 534 | DRASSIDÆ . . . . .                       | 419      |
| <i>serricollis</i> . . . . .            | 533, 534 | <i>Dyslobus</i> . . . . .                | 810      |
| <i>serrulatus</i> . . . . .             | 533, 535 | <i>lecontei</i> . . . . .                | 811      |
| <i>Creatochanes</i> . . . . .           | 262      | <i>verrucifer</i> . . . . .              | 811, 812 |
| <i>Ctenucha cressonana</i> . . . . .    | 89       | <i>Ecpantheria permaculata</i> . . . . . | 81       |
| <i>virginica</i> . . . . .              | 83       | <i>scribonia</i> . . . . .               | 81       |
| CUCUJIDÆ . . . . .                      | 451      | ELACHISTIDÆ . . . . .                    | 209      |
| CURCULIONIDÆ . . . . .                  | 821      | <i>Elonus</i> . . . . .                  | 773, 774 |
| CURIMATINÆ . . . . .                    | 259      | <i>basalis</i> . . . . .                 | 775, 776 |
| <i>Curimatus</i> . . . . .              | 259      | <i>nebulosus</i> . . . . .               | 775, 776 |
| <i>Cynodon</i> . . . . .                | 296      | <i>princeps</i> . . . . .                | 775      |
| <i>Dasytastes</i> . . . . .             | 459, 582 | <i>Emelinus</i> . . . . .                | 773, 777 |
| <i>bicolor</i> . . . . .                | 583, 586 | <i>ashmeadi</i> . . . . .                | 778      |
| <i>catalina</i> . . . . .               | 582, 583 | <i>melsheimeri</i> . . . . .             | 778      |
| <i>dispar</i> . . . . .                 | 582, 585 | <i>Emiodus</i> . . . . .                 | 260      |
| <i>otiosus</i> . . . . .                | 582, 584 | <i>Emmenotarsus</i> . . . . .            | 466      |
| <i>remissus</i> . . . . .               | 582, 583 | EPEIRIDÆ . . . . .                       | 425      |
| <i>ruficollis</i> . . . . .             | 583, 586 | <i>Epicyrtus</i> . . . . .               | 295      |
| <i>Dasytellus</i> . . . . .             | 459, 564 | ERYTHÆIDÆ . . . . .                      | 432      |
| <i>concinus</i> . . . . .               | 565      | ERYTHRININÆ . . . . .                    | 258      |
| <i>degener</i> . . . . .                | 565, 569 | <i>Erythrinus</i> . . . . .              | 258      |
| <i>elegantulus</i> . . . . .            | 565, 569 | <i>Eschatocrepis</i> . . . . .           | 459, 587 |
| <i>exilis</i> . . . . .                 | 565, 566 | <i>constrictus</i> . . . . .             | 587      |
| <i>inconspicuous</i> . . . . .          | 565, 567 | <i>Euchetes collaris</i> . . . . .       | 73       |
| <i>nigricornis</i> . . . . .            | 565, 568 | EUCHROMIDÆ . . . . .                     | 228      |
| <i>prætenuis</i> . . . . .              | 565, 566 | <i>Euclea delphinii</i> . . . . .        | 214      |
| <i>subovalis</i> . . . . .              | 565, 570 | <i>discolor</i> . . . . .                | 216      |
| <i>Dasytes</i> . . . . .                | 459, 571 | <i>indeterminata</i> . . . . .           | 214      |
| <i>breviusculus</i> . . . . .           | 572, 575 | <i>pænulata</i> . . . . .                | 215      |
| <i>cruralis</i> . . . . .               | 572, 578 | <i>plugma</i> . . . . .                  | 215      |
| <i>depressulus</i> . . . . .            | 572, 579 | EUCLEIDÆ . . . . .                       | 213      |
| <i>dissimilis</i> . . . . .             | 572, 576 | <i>Eudasytes</i> . . . . .               | 458, 460 |
| <i>expansus</i> . . . . .               | 571, 574 | <i>amplus</i> . . . . .                  | 461      |
| <i>fastidiosus</i> . . . . .            | 572, 577 | <i>oblongus</i> . . . . .                | 461, 462 |
| <i>hudsonicus</i> . . . . .             | 571, 572 | <i>ursinus</i> . . . . .                 | 461, 463 |
| <i>lineellus</i> . . . . .              | 572, 581 | <i>Eulimacodes scapha</i> . . . . .      | 223      |
| <i>macer</i> . . . . .                  | 572, 577 | EUPODIDÆ . . . . .                       | 433      |
| <i>minutus</i> . . . . .                | 572, 580 | EUPSILOBIINI . . . . .                   | 454      |
| <i>nitens</i> . . . . .                 | 571, 574 | <i>Eupsilobius</i> . . . . .             | 454      |
| <i>obtus</i> . . . . .                  | 571, 573 | <i>politus</i> . . . . .                 | 455      |
| <i>pusillus</i> . . . . .               | 572, 579 | <i>Eurelymis</i> . . . . .               | 600, 602 |
| <i>seminudus</i> . . . . .              | 572, 581 | <i>atra</i> . . . . .                    | 603, 604 |
| DASYTINI . . . . .                      | 457      | <i>flavipes</i> . . . . .                | 603, 604 |
| <i>Depressaria heracliana</i> . . . . . | 209      | <i>speculifer</i> . . . . .              | 603      |
| DERMANYSSIDÆ . . . . .                  | 433      | EURYGENIINI . . . . .                    | 626, 627 |

|  | PAGE         |   | PAGE     |
|--|--------------|---|----------|
| <i>Eusattus nanus</i> . . . . .        | 613          | <i>Lappus alacer</i> . . . . .          | 657, 660 |
| <i>Formicilla</i> . . . . .            | 640, 644     | <i>animatus</i> . . . . .               | 658, 668 |
| <i>evanescens</i> . . . . .            | 645, 646     | <i>asperulus</i> . . . . .              | 657, 664 |
| <i>gilensis</i> . . . . .              | 645, 647     | <i>bipartitus</i> . . . . .             | 658, 666 |
| <i>munda</i> . . . . .                 | 645, 646     | <i>canonicus</i> . . . . .              | 657, 664 |
| <i>scitula</i> . . . . .               | 645          | <i>cursor</i> . . . . .                 | 657, 660 |
| FRENATÆ, Lepid. . . . .                | 204          | <i>elegans</i> . . . . .                | 657, 662 |
| <i>Galleria mellonella</i> . . . . .   | 207          | <i>gibbithorax</i> . . . . .            | 658, 669 |
| GALLERIIDÆ . . . . .                   | 207          | <i>lividus</i> . . . . .                | 657, 662 |
| GAMASIDÆ . . . . .                     | 433          | <i>nitidulus</i> . . . . .              | 657, 663 |
| <i>Gasteropod cleavage</i> . . . . .   | 167          | <i>nubilatus</i> . . . . .              | 657, 661 |
| <i>Ganascus</i> . . . . .              | 774, 803     | <i>obscurus</i> . . . . .               | 657, 659 |
| <i>opimus</i> . . . . .                | 804, 805     | <i>ornatellus</i> . . . . .             | 657, 665 |
| <i>palliatu</i> s . . . . .            | 804, 806     | <i>pinalicus</i> . . . . .              | 657, 658 |
| <i>ventricosus</i> . . . . .           | 804          | <i>solivagans</i> . . . . .             | 658, 668 |
| GELECHIIDÆ . . . . .                   | 209          | <i>sturmi</i> . . . . .                 | 657, 662 |
| GEOMETRIDÆ . . . . .                   | 227          | <i>subtilis</i> . . . . .               | 658, 667 |
| <i>Gnophæla vermiculata</i> . . . . .  | 91, 228      | <i>turgidicollis</i> . . . . .          | 658, 667 |
| Granite, heat penetration in . . . . . | 138, 154     | <i>vigilans</i> . . . . .               | 657, 659 |
| <i>Syene</i> . . . . .                 | 97, 104, 158 | <i>vividus</i> . . . . .                | 658, 666 |
| <i>Halesidota caryæ</i> . . . . .      | 65           | Larvæ, Lepid. . . . .                   | 194, 203 |
| <i>harrisi</i> . . . . .               | 72           | LASIOCAMPIDÆ . . . . .                  | 229      |
| <i>maculata</i> . . . . .              | 67           | <i>Leporinus</i> . . . . .              | 261, 262 |
| <i>tessellata</i> . . . . .            | 69           | <i>Leptovectura</i> . . . . .           | 459, 594 |
| <i>Harmonia pini</i> . . . . .         | 210          | <i>adspersa</i> . . . . .               | 595      |
| <i>Harrisina americana</i> . . . . .   | 212          | <i>Lepyrus</i> . . . . .                | 821      |
| <i>Hassar</i> . . . . .                | 251          | <i>alternans</i> . . . . .              | 822, 823 |
| <i>Hemantus</i> . . . . .              | 641, 682     | <i>canadensis</i> . . . . .             | 822, 824 |
| <i>basillaris</i> . . . . .            | 683          | <i>errans</i> . . . . .                 | 822, 823 |
| <i>enodis</i> . . . . .                | 683, 684     | <i>gemellus</i> . . . . .               | 822, 823 |
| <i>floralis</i> . . . . .              | 683          | <i>geminatus</i> . . . . .              | 822, 825 |
| <i>rixator</i> . . . . .               | 683, 686     | <i>oregonus</i> . . . . .               | 822, 826 |
| <i>scenicus</i> . . . . .              | 683, 685     | <i>perforatus</i> . . . . .             | 822, 827 |
| <i>Hemiancistrus</i> . . . . .         | 253          | <i>pinguis</i> . . . . .                | 822, 825 |
| <i>Hemibrycon</i> . . . . .            | 262          | <i>Leucarcetia ocræa</i> . . . . .      | 74, 91   |
| <i>Hemiodus</i> . . . . .              | 260          | LIPARIDÆ . . . . .                      | 55       |
| <i>Hemisorubim</i> . . . . .           | 250          | <i>Listromimus</i> . . . . .            | 458, 538 |
| <i>Hemmigrammus</i> . . . . .          | 262          | <i>sericatus</i> . . . . .              | 538      |
| HEPIALIDÆ . . . . .                    | 204          | <i>Listronotus scapularis</i> . . . . . | 828      |
| HESPERIDÆ . . . . .                    | 231          | <i>tessellatus</i> . . . . .            | 828      |
| <i>Heterocampa manteo</i> . . . . .    | 226          | <i>Listrus</i> . . . . .                | 458, 540 |
| <i>Heteropacha rileyana</i> . . . . .  | 230          | <i>amplicollis</i> . . . . .            | 542, 547 |
| <i>Hoplosternum</i> . . . . .          | 256          | <i>annulatus</i> . . . . .              | 543, 559 |
| <i>Hydrocyon</i> . . . . .             | 295          | <i>balteellus</i> . . . . .             | 543, 562 |
| HYDROCYONINÆ . . . . .                 | 295          | <i>canescens</i> . . . . .              | 542, 555 |
| HYPOCHILIDÆ . . . . .                  | 419          | <i>clavicornis</i> . . . . .            | 542, 552 |
| IXODIDÆ . . . . .                      | 433          | <i>concurrens</i> . . . . .             | 543, 561 |
| JUGATÆ, Lepid. . . . .                 | 204          | <i>confusus</i> . . . . .               | 543, 557 |
| <i>Lacosoma chiridota</i> . . . . .    | 47, 210      | <i>densicollis</i> . . . . .            | 542, 548 |
| LACOSOMIDÆ . . . . .                   | 209          | <i>difficilis</i> . . . . .             | 542, 555 |
| LAPETHINI . . . . .                    | 452          | <i>extricatus</i> . . . . .             | 542, 554 |
| <i>Lappus</i> . . . . .                | 641, 657     | <i>famelicus</i> . . . . .              | 543, 563 |
|  |              | <i>fidelis</i> . . . . .                | 542, 556 |
|  |              | <i>incertus</i> . . . . .               | 543, 559 |
|  |              | <i>interruptus</i> . . . . .            | 542, 547 |
|  |              | <i>interstitialis</i> . . . . .         | 541, 545 |
|  |              | <i>luteipes</i> . . . . .               | 543, 561 |
|  |              | <i>maculosus</i> . . . . .              | 542, 550 |

|   | PAGE     |                                     | PAGE     |
|---|----------|-------------------------------------|----------|
| <i>Listrus montanus</i> . . . . .         | 542, 546 | MYCHOCERINI . . . . .               | 453      |
| <i>motschulskii</i> . . . . .             | 542, 545 | <i>Mychocerus</i> . . . . .         | 453      |
| <i>obscurellus</i> . . . . .              | 542, 553 | <i>Mylesinus</i> . . . . .          | 296      |
| <i>ornatulus</i> . . . . .                | 543, 563 | <i>Myletes</i> . . . . .            | 299, 300 |
| <i>pardalis</i> . . . . .                 | 542, 551 | MYRIAPODA . . . . .                 | 24       |
| <i>plenus</i> . . . . .                   | 542, 549 |                                     |          |
| <i>punctatus</i> . . . . .                | 543      | <i>Nannostomus</i> . . . . .        | 261      |
| <i>rotundicollis</i> . . . . .            | 541, 544 | <i>Nathicus</i> . . . . .           | 641, 655 |
| <i>rubripes</i> . . . . .                 | 543, 560 | <i>virginiae</i> . . . . .          | 655      |
| <i>senilis</i> . . . . .                  | 542, 551 | NEMATOPLEINI . . . . .              | 626, 627 |
| <i>subaneus</i> . . . . .                 | 542, 549 | <i>Nocibiotes</i> . . . . .         | 618      |
| <i>tibialis</i> . . . . .                 | 543      | <i>acutus</i> . . . . .             | 620      |
| <i>tritus</i> . . . . .                   | 543, 557 | <i>caudatus</i> . . . . .           | 621      |
| <i>uniformis</i> . . . . .                | 542, 552 | <i>gracilis</i> . . . . .           | 619      |
| <i>variegatus</i> . . . . .               | 543, 558 | <i>rubripes</i> . . . . .           | 621      |
| LITHOSIIDÆ . . . . .                      | 226      | NOCTUIDÆ . . . . .                  | 225      |
| <i>Lophoderus politana</i> . . . . .      | 208      | <i>Nola minuscula</i> . . . . .     | 226      |
| <i>Loricaria</i> . . . . .                | 253      | <i>Nomidus</i> . . . . .            | 810, 818 |
| LYCENIDÆ . . . . .                        | 230      | <i>abruptus</i> . . . . .           | 819      |
| LYCOSIDÆ . . . . .                        | 429      | <i>Notibius</i> . . . . .           | 622      |
| LYMANTRIIDÆ . . . . .                     | 228      | NOTODONTIDÆ . . . . .               | 226      |
|   |          | <i>Notoxus</i> . . . . .            | 642, 756 |
| <i>Macratrìa</i> . . . . .                | 637      | <i>alamedæ</i> . . . . .            | 769      |
| <i>brunnea</i> . . . . .                  | 638      | <i>austinianus</i> . . . . .        | 765      |
| <i>ovicollis</i> . . . . .                | 638      | <i>balteatus</i> . . . . .          | 759      |
| MACRATRIINI . . . . .                     | 626, 637 | <i>constrictus</i> . . . . .        | 768      |
| <i>Macrodon</i> . . . . .                 | 258      | <i>debilitans</i> . . . . .         | 762      |
| MACROLEPIDOPTERA . . . . .                | 224      | <i>desertus</i> . . . . .           | 767      |
| <i>Malporus</i> . . . . .                 | 641, 651 | <i>dinocerus</i> . . . . .          | 766      |
| <i>blandus</i> . . . . .                  | 651, 654 | <i>filicornis</i> . . . . .         | 766      |
| <i>cinctus</i> . . . . .                  | 651, 653 | <i>humboldti</i> . . . . .          | 764      |
| <i>formicarius</i> . . . . .              | 651, 652 | <i>lustrellus</i> . . . . .         | 763      |
| <i>properus</i> . . . . .                 | 651, 653 | <i>microcerus</i> . . . . .         | 760      |
| <i>Mastoremus</i> . . . . .               | 627, 630 | <i>montanus</i> . . . . .           | 760      |
| <i>longicornis</i> . . . . .              | 631      | <i>nevadensis</i> . . . . .         | 763      |
| <i>Mecomycet</i> . . . . .                | 459, 595 | <i>pictus</i> . . . . .             | 770      |
| <i>facetus</i> . . . . .                  | 596, 597 | <i>robustus</i> . . . . .           | 768      |
| <i>omalinus</i> . . . . .                 | 596      | <i>spatulifer</i> . . . . .         | 761      |
| <i>Mecyna reversalis</i> . . . . .        | 207      | NYPHALIDÆ . . . . .                 | 231      |
| <i>Mecynotarsus</i> . . . . .             | 642, 771 |                                     |          |
| <i>flavicans</i> . . . . .                | 772      | <i>Obelisk, New York</i> . . . . .  | 93       |
| MEGALOPYGIDÆ . . . . .                    | 212      | <i>Odontopyge furcata</i> . . . . . | 36       |
| <i>Megeleates</i> . . . . .               | 623      | <i>Odontostilbe</i> . . . . .       | 288      |
| <i>sequoiarum</i> . . . . .               | 624      | <i>Oiketicus kirbyi</i> . . . . .   | 205      |
| <i>Melbonus</i> . . . . .                 | 820      | <i>townsendi</i> . . . . .          | 205      |
| <i>scapalis</i> . . . . .                 | 821      | <i>Oreta rosea</i> . . . . .        | 227      |
| <i>Melittia ceto</i> . . . . .            | 211      | <i>Orgyia antiqua</i> . . . . .     | 55       |
| MELYRIDÆ . . . . .                        | 456      | <i>cana</i> . . . . .               | 62       |
| MELYRINÆ . . . . .                        | 457      | <i>definita</i> . . . . .           | 65       |
| MELYRINI . . . . .                        | 457, 599 | <i>leucostigma</i> . . . . .        | 59       |
| <i>Merismopedia</i> . 346, 348, 350-352,  | 354, 355 | OTIORHYNCHIDÆ . . . . .             | 809      |
| <i>Micrococcus</i> . . 346, 347, 349-351, | 353, 354 | <i>Oxydoras</i> . . . . .           | 251      |
| <i>Microdus</i> . . . . .                 | 260      | OXYOPIDÆ . . . . .                  | 430      |
| MICROLEPIDOPTERA . . . . .                | 205      |                                     |          |
| MURMIDIINÆ . . . . .                      | 451      | <i>Packardia elegans</i> . . . . .  | 222      |
| MURMIDIINI . . . . .                      | 454      | <i>geminata</i> . . . . .           | 222      |
|   |          | <i>Panaque</i> . . . . .            | 256      |
|   |          | <i>Pantographa limata</i> . . . . . | 207      |

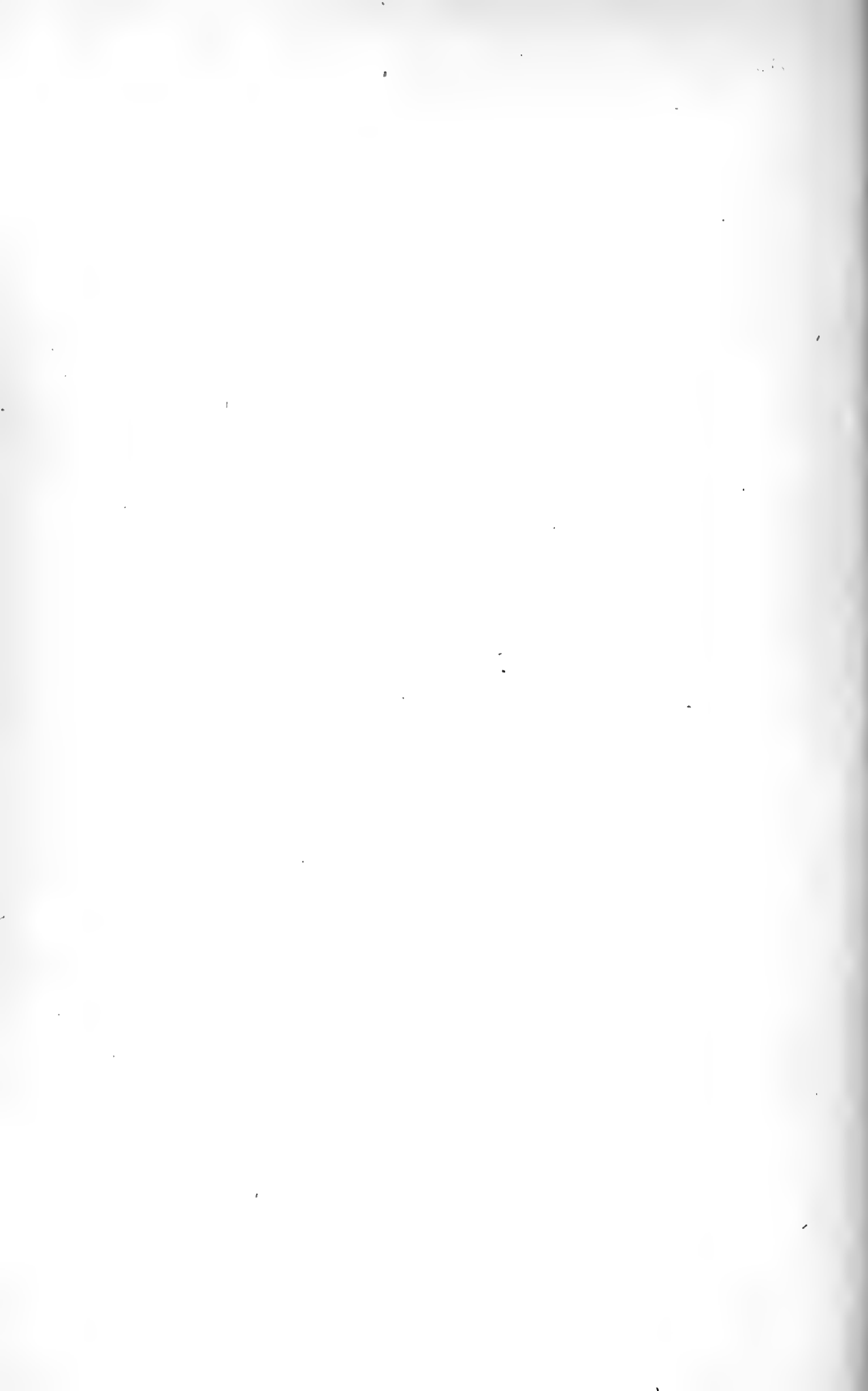


|                                   | PAGE     |                                 | PAGE     |
|-----------------------------------|----------|---------------------------------|----------|
| PAPILIONIDÆ . . . . .             | 231      | PYROMORPHIDÆ . . . . .          | 211      |
| Paracampsus . . . . .             | 836      | Pyrrharcia isabella . . . . .   | 76       |
| subtropicus . . . . .             | 837      | Pyrrhulina . . . . .            | 258, 256 |
| Paradesmus thysanopus . . . . .   | 25       | Retocomus . . . . .             | 627, 628 |
| Parallax, stellar . . . . .       | 1, 301   | decorellus . . . . .            | 629      |
| Parasa chloris . . . . .          | 217      | gratus . . . . .                | 629      |
| PEDILINI . . . . .                | 626, 637 | RHADALINÆ . . . . .             | 457, 604 |
| Pergetus . . . . .                | 627, 636 | Rhadalus . . . . .              | 604      |
| PERICOPIDÆ . . . . .              | 228      | lecontei . . . . .              | 605, 606 |
| Perophora melsheimeri . . . . .   | 50       | testaceus . . . . .             | 605      |
| PHALANGIDA . . . . .              | 431      | Rhamdia . . . . .               | 250      |
| Pheosia dimidiata . . . . .       | 227      | RHYNCLOPHIDÆ . . . . .          | 432      |
| Phobetrion pitheciium . . . . .   | 218      | Rœbioides . . . . .             | 295      |
| tetradaetylum . . . . .           | 219      | Ryssematus . . . . .            | 832      |
| PHOLCIDÆ . . . . .                | 419      | annectens . . . . .             | 832, 834 |
| Phomalus . . . . .                | 773, 785 | grandicollis . . . . .          | 832, 833 |
| brunniipennis . . . . .           | 786      | medialis . . . . .              | 833, 834 |
| saginitus . . . . .               | 786, 787 | parvulus . . . . .              | 833, 835 |
| Phryganidia californica . . . . . | 89       | Sandytes . . . . .              | 774, 806 |
| PHYCITIDÆ . . . . .               | 207      | ptinoides . . . . .             | 807      |
| Phyllodesma americana . . . . .   | 230      | Sannina exitiosa . . . . .      | 210      |
| <i>Piabuca</i> . . . . .          | 261      | Sapintus . . . . .              | 641, 732 |
| PIERIDÆ . . . . .                 | 231      | colonus . . . . .               | 733, 736 |
| Pimelodella . . . . .             | 250      | corticalis . . . . .            | 733, 739 |
| PIMELODINÆ . . . . .              | 250      | festinans . . . . .             | 733, 739 |
| Pimelodus . . . . .               | 250      | fulvipes . . . . .              | 733, 735 |
| PLATYPTERICIDÆ . . . . .          | 45       | hispidulus . . . . .            | 733, 736 |
| Platypteryx arcuata . . . . .     | 227      | mollis . . . . .                | 733, 740 |
| Plecostomus . . . . .             | 253      | pubescens . . . . .             | 733, 733 |
| Plectromodes . . . . .            | 829      | pusillus . . . . .              | 733, 737 |
| armatus . . . . .                 | 830, 831 | rusticus . . . . .              | 733, 734 |
| paludatus . . . . .               | 830      | timidus . . . . .               | 733, 741 |
| Plodia interpunctella . . . . .   | 208      | Sarcina . . . . .               | 352, 353 |
| <i>Pœcilurichthys</i> . . . . .   | 262      | Sarrothripa revayana . . . . .  | 226      |
| Polydesmus arcticollis . . . . .  | 236      | SATURNINA . . . . .             | 232      |
| cæsius . . . . .                  | 236      | Scanylus . . . . .              | 774, 800 |
| granulatus . . . . .              | 238      | leteolus . . . . .              | 801      |
| woodianus . . . . .               | 236      | pruinosis . . . . .             | 801      |
| Polyphylla pacifica . . . . .     | 607      | SCARABÆIDÆ . . . . .            | 607      |
| Prionoxystus robiniae . . . . .   | 91       | <i>Schizodon</i> . . . . .      | 261      |
| Pristoscelis . . . . .            | 458, 459 | Scolependra morsitans . . . . . | 37       |
| grandiceps . . . . .              | 460      | SCORPIONIDA . . . . .           | 432      |
| Prochilodus . . . . .             | 259, 260 | Seytonotus . . . . .            | 233      |
| Pseudallonyx . . . . .            | 459, 593 | arcticollis . . . . .           | 236      |
| plumbeus . . . . .                | 553      | cæsius . . . . .                | 236      |
| Pseudariotus . . . . .            | 774, 790 | cavernarus . . . . .            | 237      |
| amicus . . . . .                  | 790, 791 | digitatus . . . . .             | 238      |
| notatus . . . . .                 | 790, 791 | granulatus . . . . .            | 238      |
| Pseudoplatystoma . . . . .        | 250      | laevicollis . . . . .           | 235, 238 |
| PSEUDOSCORPIONIDA . . . . .       | 431      | nodulosus . . . . .             | 235      |
| PSYCHIDÆ . . . . .                | 47, 204  | scabricollis . . . . .          | 238      |
| PTEROPHORIDÆ . . . . .            | 211      | setiger . . . . .               | 237      |
| Pterygoplichthys . . . . .        | 256      | woodianus . . . . .             | 236      |
| Pygidium . . . . .                | 252      | Seiraretia echo . . . . .       | 80       |
| Pygocentrus . . . . .             | 297      | Sermysatus . . . . .            | 833      |
| Pygoprists . . . . .              | 296      | SERRASALMONINÆ . . . . .        | 296      |
| PYRALIDINA . . . . .              | 207      |                                 |          |
| PYRAUSTIDÆ . . . . .              | 207      |                                 |          |

|                                   | PAGE     |                                | PAGE     |
|-----------------------------------|----------|--------------------------------|----------|
| Serrasalmus . . . . .             | 297      | TINEINA . . . . .              | 208      |
| Sesia tipuliformis . . . . .      | 211      | Tolyte velleda . . . . .       | 229      |
| SESIIDÆ . . . . .                 | 210      | Tomoderus . . . . .            | 641, 648 |
| Sibine stimulea . . . . .         | 216      | constrictus . . . . .          | 648, 649 |
| trimaculata . . . . .             | 217      | impressulus . . . . .          | 648, 649 |
| vidua . . . . .                   | 216      | interruptus . . . . .          | 648      |
| SILURIDÆ . . . . .                | 250      | Tonibiastes . . . . .          | 617      |
| Sisyrosea inornata . . . . .      | 219      | Tonibius . . . . .             | 622      |
| SOLPUGIDA . . . . .               | 432      | TORTRICIDÆ . . . . .           | 208      |
| SPHINGIDÆ . . . . .               | 232      | Tortricidia fasciola . . . . . | 221      |
| Spilosoma virginica . . . . .     | 78, 79   | minuta . . . . .               | 221      |
| Spirostreptus anodontus . . . . . | 32       | pallida . . . . .              | 220      |
| tripartitus . . . . .             | 31       | TORTRICINA . . . . .           | 208      |
| variabilis . . . . .              | 28       | Trachycorystes . . . . .       | 252      |
| STAPHYLINIDÆ . . . . .            | 436      | Trichochrous . . . . .         | 458, 466 |
| Stars, measures of . . . . .      | 381      | ænescens . . . . .             | 473, 529 |
| Stereopalpus . . . . .            | 627, 631 | agrestis . . . . .             | 469, 476 |
| impressicollis . . . . .          | 632, 635 | antennatus . . . . .           | 469, 484 |
| incanus . . . . .                 | 632      | apicalis . . . . .             | 470, 492 |
| indutus . . . . .                 | 632, 633 | ater . . . . .                 | 477      |
| nimius . . . . .                  | 632, 634 | atricornis . . . . .           | 469, 482 |
| rufipes . . . . .                 | 632, 634 | barbaræ . . . . .              | 472, 518 |
| subalbicans . . . . .             | 632, 636 | brevicornis . . . . .          | 471, 508 |
| variipes . . . . .                | 632, 633 | brevipilosus . . . . .         | 472, 517 |
| Sydates . . . . .                 | 458, 537 | brevis . . . . .               | 468, 474 |
| zonatus . . . . .                 | 537      | californicus . . . . .         | 474      |
| Sydatopsis . . . . .              | 458, 536 | castus . . . . .               | 469, 479 |
| longicornis . . . . .             | 536      | ciliatus . . . . .             | 469, 481 |
|                                   |          | comatus . . . . .              | 473, 523 |
| Tanarthropsis . . . . .           | 750, 751 | compactus . . . . .            | 468, 474 |
| Tanarthrus . . . . .              | 642, 749 | conformis . . . . .            | 511      |
| alutaceus . . . . .               | 750, 755 | conspersus . . . . .           | 472, 514 |
| brevipennis . . . . .             | 750, 751 | convergens . . . . .           | 470, 491 |
| densus . . . . .                  | 750, 754 | crinifer . . . . .             | 473, 521 |
| nubifer . . . . .                 | 750, 752 | curticollis . . . . .          | 472, 511 |
| salicola . . . . .                | 750, 754 | cuspidatus . . . . .           | 471, 503 |
| salinus . . . . .                 | 750      | cylindricus . . . . .          | 469, 477 |
| tricolor . . . . .                | 750, 753 | discipulus . . . . .           | 469, 484 |
| Tanilotes . . . . .               | 774, 798 | egenus . . . . .               | 470, 493 |
| densus . . . . .                  | 799      | erythropus . . . . .           | 470, 490 |
| lacustris . . . . .               | 799      | exiguus . . . . .              | 470, 497 |
| TENEBRIONIDÆ . . . . .            | 610      | fallax . . . . .               | 470, 499 |
| TETRAGONOPTERINÆ . . . . .        | 262      | femoralis . . . . .            | 469, 485 |
| Tetragonopterus . . . . .         | 262      | fimbriatus . . . . .           | 471, 504 |
| TETRANYCHIDÆ . . . . .            | 433      | fraternus . . . . .            | 469, 477 |
| THERAPHOSIDÆ . . . . .            | 419      | fulvescens . . . . .           | 473, 523 |
| THERIDIDÆ . . . . .               | 423      | fulvotarsis . . . . .          | 469, 483 |
| Thicanus . . . . .                | 641, 670 | fulvovestitus . . . . .        | 470, 497 |
| annectens . . . . .               | 672      | funebri . . . . .              | 471, 501 |
| californicus . . . . .            | 670, 672 | fuscus . . . . .               | 471, 506 |
| franciscanus . . . . .            | 670, 673 | griseus . . . . .              | 469, 486 |
| minus . . . . .                   | 670, 672 | hirtellus . . . . .            | 473, 522 |
| rejectus . . . . .                | 670, 671 | hystrix . . . . .              | 472, 517 |
| texanus . . . . .                 | 670      | inæqualis . . . . .            | 470, 500 |
| THOMISIDÆ . . . . .               | 426      | incipiens . . . . .            | 470, 489 |
| Thyce pistoria . . . . .          | 607      | indigens . . . . .             | 470, 489 |
| riversi . . . . .                 | 608      | indutus . . . . .              | 471, 503 |
| Thyridopteryx ephemeræformis      | 54, 205  | innocens . . . . .             | 470, 492 |

|  | PAGE     |                                    | PAGE     |
|--|----------|------------------------------------|----------|
| <i>Trichochrous insignis</i> . . . . . | 471, 510 | TROMBIDIDÆ . . . . .               | 432      |
| <i>irrasus</i> . . . . .               | 472, 521 | <i>Tyria jacobææ</i> . . . . .     | 226      |
| <i>laticollis</i> . . . . .            | 469, 478 | TYROGLYPHIDÆ . . . . .             | 433      |
| <i>lobatus</i> . . . . .               | 472, 516 |                                    |          |
| <i>lucidus</i> . . . . .               | 473, 527 | <i>Utetheisa bella</i> . . . . .   | 82       |
| <i>mexicanus</i> . . . . .             | 472, 515 |                                    |          |
| <i>modestus</i> . . . . .              | 469, 487 | <i>Vacusus</i> . . . . .           | 641, 674 |
| <i>mucidus</i> . . . . .               | 471, 508 | <i>arcanus</i> . . . . .           | 675, 679 |
| <i>nigrinus</i> . . . . .              | 473, 529 | <i>bizonatus</i> . . . . .         | 676      |
| <i>nubilatus</i> . . . . .             | 470, 495 | <i>confinis</i> . . . . .          | 675, 678 |
| <i>oregonensis</i> . . . . .           | 468, 475 | <i>desertorum</i> . . . . .        | 675, 680 |
| <i>pedalis</i> . . . . .               | 473, 528 | <i>formicetorum</i> . . . . .      | 675, 681 |
| <i>politus</i> . . . . .               | 473, 531 | <i>fulvomicans</i> . . . . .       | 676      |
| <i>prominens</i> . . . . .             | 471, 502 | <i>lætus</i> . . . . .             | 675, 676 |
| <i>propinquus</i> . . . . .            | 470, 496 | <i>monitor</i> . . . . .           | 675, 677 |
| <i>pruinus</i> . . . . .               | 471, 505 | <i>nigritulus</i> . . . . .        | 675, 678 |
| <i>pudens</i> . . . . .                | 470, 488 | <i>prominens</i> . . . . .         | 675, 680 |
| <i>punctipennis</i> . . . . .          | 473, 532 | <i>supplex</i> . . . . .           | 675, 676 |
| <i>quadricollis</i> . . . . .          | 472, 513 | <i>suspectus</i> . . . . .         | 675, 682 |
| <i>remotus</i> . . . . .               | 472, 514 | <i>thoracicus</i> . . . . .        | 676      |
| <i>reversus</i> . . . . .              | 473, 527 | <i>vicinus</i> . . . . .           | 676      |
| <i>rufipennis</i> . . . . .            | 472, 516 | <i>Vanonus</i> . . . . .           | 774, 791 |
| <i>rufipes</i> . . . . .               | 486      | <i>calvescens</i> . . . . .        | 792, 793 |
| <i>rusticus</i> . . . . .              | 473, 530 | <i>floridanus</i> . . . . .        | 793, 797 |
| <i>separatus</i> . . . . .             | 470, 487 | <i>huronius</i> . . . . .          | 792, 796 |
| <i>seriellus</i> . . . . .             | 471, 506 | <i>piceus</i> . . . . .            | 792, 794 |
| <i>sexualis</i> . . . . .              | 473, 524 | <i>sagax</i> . . . . .             | 793, 796 |
| <i>simulans</i> . . . . .              | 469, 486 | <i>tuberculifer</i> . . . . .      | 792, 794 |
| <i>sinuosus</i> . . . . .              | 469, 479 | <i>vigilans</i> . . . . .          | 793, 795 |
| <i>sobrinus</i> . . . . .              | 471, 507 | <i>wickhami</i> . . . . .          | 793, 797 |
| <i>sonomæ</i> . . . . .                | 473, 525 | <i>Vectura</i> . . . . .           | 459, 591 |
| <i>sordidus</i> . . . . .              | 472, 519 | <i>albicans</i> . . . . .          | 592      |
| <i>sparsus</i> . . . . .               | 469, 481 | <i>longiceps</i> . . . . .         | 591, 592 |
| <i>squalidus</i> . . . . .             | 473, 524 | <i>Vitula edmandsi</i> . . . . .   | 207      |
| <i>stricticollis</i> . . . . .         | 473, 532 |                                    |          |
| <i>subcalvus</i> . . . . .             | 471, 500 | <i>Xiphorhamphus</i> . . . . .     | 295      |
| <i>suffusus</i> . . . . .              | 470, 495 | <i>Xiphystoma</i> . . . . .        | 296      |
| <i>suturalis</i> . . . . .             | 472, 511 | XYLOPHILINÆ . . . . .              | 625, 772 |
| <i>tectus</i> . . . . .                | 472, 519 | <i>Xyloryctes faunus</i> . . . . . | 609      |
| <i>tejonius</i> . . . . .              | 524      |                                    |          |
| <i>testaceus</i> . . . . .             | 470, 498 | <i>Zeuzera pyrina</i> . . . . .    | 206      |
| <i>texanus</i> . . . . .               | 473, 526 | <i>Zonantes</i> . . . . .          | 773, 779 |
| <i>transversus</i> . . . . .           | 469, 480 | <i>ater</i> . . . . .              | 780, 785 |
| <i>umbratus</i> . . . . .              | 470, 494 | <i>fasciatus</i> . . . . .         | 780, 783 |
| <i>varius</i> . . . . .                | 472, 512 | <i>hubbardi</i> . . . . .          | 780, 782 |
| <i>vilis</i> . . . . .                 | 471, 509 | <i>nubifer</i> . . . . .           | 780      |
| <i>villosus</i> . . . . .              | 472, 520 | <i>schwarzi</i> . . . . .          | 780, 783 |
| <i>vittiger</i> . . . . .              | 471, 502 | <i>signatus</i> . . . . .          | 780, 781 |
| <i>Trogophlæus salicola</i> . . . . .  | 450      | <i>subfasciatus</i> . . . . .      | 780, 782 |
|  |          | <i>tricuspis</i> . . . . .         | 780, 785 |









New York Botanical Garden Library



3 5185 00258 3506



